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WASH TUB SNOW. A SCIENCE PROJECT. *(See Page 164.)*
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IN THIS ISSUE . . .

Teaching Science for the Atomic Age - - - - - 157
NSTA—in Its Fourth Year - 159
This and That - - - - - 160
Converting Surplus Aircraft Instruments into Teaching Devices - - - - - - 161
Some Important Principles in Physics Which Require Demonstration in Chemistry 162
A Laboratory Method for High School Physics - - 165
Scientists Want Freedom - 166
Chats with Science Teachers-I 168
Integration Test - - - - 169
A Science Project as a Community Project - - 170
Dissolving the Walls of the Classroom - - - 174
Do You Use Audio-Visual Aids? 176
Adaptable Equipment for Use in General Science - - 178
News and Announcements - 180
Resolutions of NSTA Cincinnati Convention - - 181

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Listed in Education Index

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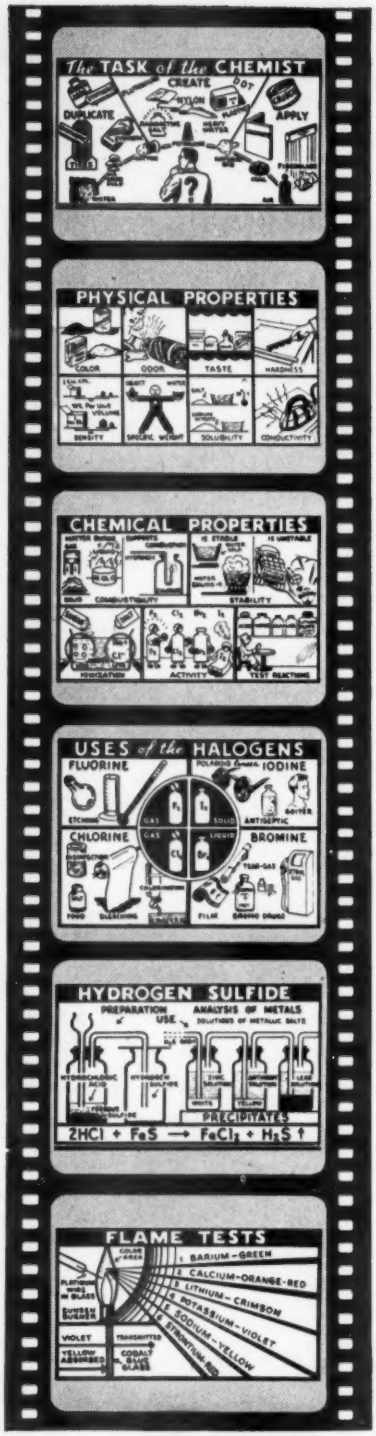

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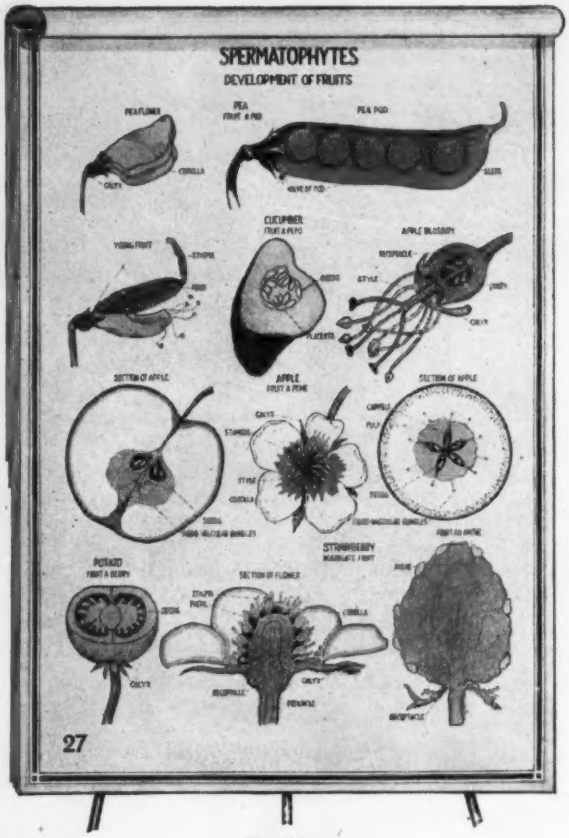

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The Science Teacher

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VOLUME XIV DECEMBER, 1947 NUMBER 4

Teaching Science for the Atomic Age

ALEX B. NOVIKOFF

Biology Department, Brooklyn College

WE MUST hope that the explosion of a small bomb in New Mexico, another on Hiroshima, a third on Nagasaki, and a few more on some warships in the Pacific Ocean will be enough to rouse the peoples of the world to act, in sufficient strength and in time, to prevent atom bombs from destroying us all.

Is it too much to hope that there will come also a general recognition in society and in our schools that our educational system, "from the cradle to the Ph.D . . . adjusting to changes decades late . . . is still founded on non-scientific scholasticism"?[2]

For many years before the atom bomb we had been living in a scientific age. Many of our people albeit too few, have for some time been enjoying benefits of our advanced science. But even today only a handful understand the universe about them. This is a commentary both on the limited educational opportunities offered our people and the inadequate science teaching in our schools.

The average citizen has always wanted to learn and to understand. Witness the popularity of natural sciences at institutions like the Jefferson School of Social Science, where mature men and women come to class after a long day at office or factory. Unquestionably the need for adult education will increase in the "Atomic Age". Society, schools, and science teachers must prepare to meet this demand adequately.

THESE MEN and women do not wish to become science specialists. Neither do most of our school children and the majority of college students. Our general aims in teaching them science are basically the same, whether they be 12 years old, 15, 19, or 49. These aims can be simply stated: to help the individual understand phenomena in the world about him, and 2) to teach the social relations of science so that the individual understands the role of science in modern society and can act intelligently on scientific matters.

Genuine science teaching should emphasize neither rote learning of fact upon fact, nor the mastery of certain techniques; it should stress basic principles and social implications of the subject. It should help our students, including the future specialists, to become human beings. We want them to be world citizens who understand the essential one-ness of all mankind. And we want them to act upon that understanding—to help eliminate from society all practices based upon prejudice. We need men and women able to resist the prejudice and pressures which overcame the German nation, scientists along with the rest. Of the specialists as of the general citizen we expect a deep sense of social values. We expect the scientists to take part in shaping the "Atomic Age" with some of the same vigor displayed in shaping the atom bomb.

TO ILLUSTRATE and explain basic principles, a careful selection of facts is necessary. The more these facts center about problems of everyday life, the more significant will the principles be to the student. Facts and principles need to be presented so as to convey: 1) the manner in which science develops, 2) the way in which relationships are sought and discovered in known facts, and 3) how the discovery of these relationships leads to new facts. The significance of newly-discovered facts, and areas still unknown, needs to be discussed so as to demonstrate that science

1—Address given at the Tenth Annual Education Conference of the New York Teachers Union, March 2, 1946.

2—"Science and Education", *A.A.A.S. Bulletin*, vol. 5, 1946, p. 10.

is a constantly expanding body of knowledge and not a closed catalogue of facts.

To provide understanding, it is not enough simply to describe things. It is essential that we explain them, that we show cause and effect relationships at every point

A frequent complaint of medical school instructors, writes a college professor in a communication to *Science*, is that "college fails most seriously in the formal education of the student. Their faculty of logical reasoning and independent thinking are not sufficiently developed".[3] And we have all heard college instructors complain that students are trained in the high schools simply to follow teacher and text blindly and to regurgitate at the expected moment what they have been previously spoonfed in predigested form. I suspect that many high school teachers have similar complaints about elementary school teaching.

WHY ARE students slow to develop "logical reasoning and independent thought"? That the fault lies with our teaching is suggested by the results of a recent study on the development of children's concepts of casual relations. Seven hundred and thirty-two boys and girls, ranging in age from 8 to 16, in grades 3 to 8 in three Minneapolis schools, were asked questions about physical phenomena, beginning usually with "Why?" or "What causes?" Their answers were judged in terms of adequacy as explanations of the phenomena. The results indicate that "training or experience, as acquired through the schools, outweighs intelligence or innate maturational factors in determining the ability of children to answer the questions of this test . . . Undoubtedly maturation and innate factors have a delimiting effect on casual thinking, but the answers to specific questions are more closely related to school experience and whatever that implies in the way of direct or indirect instruction and training."[4]

This is further borne out by the virtual absence of correct casual relations in the thinking about biological phenomena on the part of college students, even those who have had high school biology and the traditional college course in General Biology. "Why does the heart beat?" To bring food-laden blood to all cells of the organism. "Why does the leaf bend to the light?" To intercept more energy for photosynthesis. There is no awareness that ascribing such purposive behavior to the heart or the plant imparts the ability to reason and to look into the future, in one case to a small individual part of the organism, and in the other, to an organism which lacks a nervous system, let alone a brain! How amazed the students are when they hear for the first time that the answers to these questions require a discussion of cardiac muscle contraction, in the first case, and the distribution and activity of plant growth hormones, in the second case.

SURELY it is not the inherent difference in the nature of the phenomena which accounts for the absence of correct casual thinking about biological phenomena by students who already think correctly about physical phenomena. It stems in large measure from a basic failing of biology teaching. The teacher of biology needs to make a determined effort to overcome the carry-over from the anthropomorphism of early childhood, in which animals and plants are endowed with human physical and social attributes. Yet I dare say that most science teachers in elementary and high schools and many instructors of college biology are blissfully unaware of the problem.

Let us agree that our task is to develop the individual's "logical reasoning and independent thinking" as we teach the social relations of science and important scientific principles necessary for an understanding of problems of current life.

If we are to succeed in this task, a certain change of attitude on the part of Boards of Education and Boards of Estimate seems necessary. They need to recognize a few elementary pedagogic realities. How can a laboratory class of 40 students in high school chemistry be taught adequately? How can one laboratory be sufficient for 500 students of chemistry? (This is the situation in one of our best New York high schools). How can you develop "independent thought" in biology class when inadequate provision is made for

Continued on Page 184

3—Viktor Hamburger, "Biology in the Premedical Curriculum", *Science*, vol. 102, 1945, p. 511.

4—Jean Marquis Deutsche: "The Development of Children's Concepts of Casual Relations", in Barker, Kounin and Wright: "Child Behavior and Development", New York, 1943, p. 129.

President's Page — By Morris Meister

NSTA—In Its Fourth Year

IT IS exceedingly strange that the most important pronouncements on science education in the last three decades have *not* come from organized teachers of science. Yet, the authors of these pronouncements *were* teachers of science. To mention but a few, the 1920 Report of The Committee on Science came from The Commission on The Reorganization of Secondary Education; the 31st and 46th Yearbooks were sponsored by the National Society for The Study of Education; the Report on Science in Genreal Education was written under the aegis of the Progressive Education Association; the War Courses in Science resulted from the close cooperation of the U. S. Office of Education and the War Department; the Report on Present Effectiveness of Science Teaching in Our Schools was the work of the AAAS Cooperative Committee on Science Teaching.

These documents have had and are having considerable influence upon the science classrooms of the nation. Where they failed or were minimal in effect, the cause can be traced to a lack of participation on the part of organized teachers of science. Without such organization, there is no good means of widespread dissemination and discussion. When teachers in great numbers freely join an association, and that association produces a report, in democratic fashion, the members tend to have confidence in the recommendations. The resulting influence upon professional practice is thus enhanced. Pronouncements from "above" or from "without" are too often regarded with mild interest; sometimes with suspicion.

It seems to us that the Atomic Age has brought new responsibility to teachers of science. They have gained new dignity in the eyes of their colleagues. It is high time that they emerge for a while from their local interests. They must become educational statesmen in a national effort to develop for science education the place which it deserves—a place which the new world expects them to assume.

THOSE who established the National Science Teachers Association are convinced that such an organization can contribute substantially to the progress of science education at the level where progress counts most—at the grass roots. We are essentially a classroom teacher group, concerned with the entire sequence of science studies, all of the sciences and the needs of science teaching everywhere in the country. We know from experience that a strong voice for science teachers nationally brings increased effectiveness to all of the sciences and to the efforts of local and regional associations.

In its fourth year, NSTA is gaining momentum. Its Bulletins are making an impression upon science teachers, supervisors and administrators. Its services are much in demand; it membership has doubled and, with this, financial support is growing. There are two next steps.

First, we must have a full-time executive secretary who will coordinate a multiplicitv of vital activities and guide the steadilv growing services to science teachers.

Second, we must lay plans for a pronouncement on the vital issues of science teaching which, for once, will come from the organized science teachers of our land.

We welcome comment from our members and readers of this Journal.

MORRIS MEISTER, President.

N.S.T.A. LUNCHEON

The annual luncheon of the National Science Teachers Association will be held in the Hotel Sherman, Chicago, Illinois, at 12:30 noon on Monday, December 29, 1947. The program will include a tribute to the life and work of Otis William Caldwell. The speaker will be Dr. Harlow Shapley, president of the American Association for the Advancement of Science.

Tickets may be obtained by writing to Nathan Neal, 49 East 33rd Street, New York 16, New York. During the convention, tickets may be obtained at the ticket booth in the Hotel Sherman or in the Stevens Hotel.

This and That

NORMAN R. D. JONES
Vice-President and Membership Chairman

Mr. J. A. Perino, past-president of the California Science Teachers Association. Northern Section, recently received a promotion to Head of the Science Department of the Polytechnic High School. He is also editor of their local science news letter.

Dr. J. S. Richardson of Miami University, Oxford, Ohio, was one of the principal speakers for the Central Ohio Teachers meeting at Columbus. Thanks for the nice "plug" that you put in for N.S.T.A.

Miss Julia Armstrong, Northa Dakota State Director, has been promoted to the principalship at Mott, North Dakota.

Mr. Earl H. Schroer is now vice-principal of the Benton High School in Omaha. Even though he now has administrative duties he maintains an active interest in science.

Dr. R. Will Burnett is located at the University of Illinois, Urbana, Illinois. Congratulations on your promotion.

Miss Anna E. Burgess of Cleveland, Ohio, who has served us so ably as our Ohio State Director, recently received a nice advancement, being appointed as the liaison between the elementary superintendent and about forty elementary principals.

Miss Mary Creager, well known through her activity in the Illinois Junior Academy of Science, received a fine promotion in her new position at Eastern Illinois State College.

Western Division A.A.A.S. Meeting

The San Francisco Area will be host to the 1948 A.A.A.S. Western Division Meeting next June. N.S.T.A. through the cooperation of its affiliate the California Science Teachers Association, Northern Section, will arrange for meetings to be held which I am sure will be of interest to all.

The committee appointed to develop the program is: Edward W. Song, Chairman, J. A. Perino, M. Van Waynen, Secil Kyle, Maury Gould and W. Bayard Buckham.

Reports from Affiliated Groups

Reports of many recent excellent meetings of our affiliated organizations have been coming in with numerous N.S.T.A. memberships secured. Some of these have come from: Dick Lape of the Buffalo, New York district; Elmer Headlee, Secretary of the Missouri State Association; Mrs. Baker from the Atlanta, Georgia District; four Nebraska District meetings by Mr. Jeffery of Lincoln; Mr. Baker of Norfolk; Mr. Howland of Hasting; and Mr. Busch of Omaha; Mr. Jensen from South Dakota; Miss Burgess of Cleveland.

For its fall meeting the California Science Teachers Association, Northern Section, visited the cyclotron at Berkeley. An additional feature was the lecture on the "Theory of Accelerators" by Dr. Wolfgang Pinofsky.

Excellent progress is reported on the formation of the California Council of Science Teachers, an organization to coordinate the work of the several California Science Teachers Associations.

The Nebraska Science Teachers Association recently held a Board of Directors planning session for the furtherance of its work.

Can You Equal This?

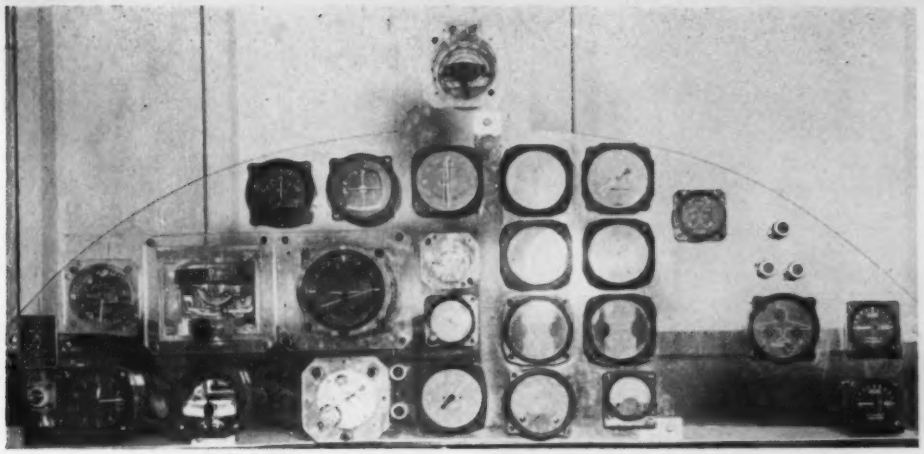
Mr. Leroy Alford of Buena Vista, Colorado, must have set a record at the recently held Science Section Meeting of the Southern Division of the Colorado Education Association. N.S.T.A. membership folders had been placed on all chairs and not a single one was left on them at the close of the meeting. A very fine program was presented.

Science Fair

St. Louis, Missouri joins the ever growing list of cities presenting a Science Fair. Through the cooperation of Washington University, The St. Louis Star-Times newspaper, Science Clubs of America and N.S.T.A. preliminary details have been worked out.

The "Fair" will be held March 29-April 2, 1948 at the Washington University Field House. It is open to all public, private and parochial schools in the Greater St. Louis area. Preliminary negotiations for the Fair were conducted by John Marston of the Star-

Continued on Page 188



Surplus aircraft instruments can be mounted attractively on plastic for use in aeronautics courses.

Converting Aircraft Instruments Into Teaching Devices

ALEXANDER JOSEPH

Bronx High School of Science, New York City

MANY high school science teachers have received aircraft instruments from the War Assets Administration. Each instrument is naturally useful for high school classes in aeronautics. In addition these instruments can serve as practical applications of principles in physics. In the photograph the instruments have been transferred into plastic cases to make them visible to the students and then mounted on a clear plastic panel. The best examples of instruments in plastic cases are the compass at the top of the panel and the gyro-compass and air-speed indicator shown as the first two instruments in the second row.

Making the plastic cases is a very simple matter. It is easier to make rectangular or square cases than it is to make cylindrical cases. In all instruments, the case made must be air tight. Two plastics may be used. The least expensive and easiest to work is cellulose acetate. The solvent used for making joints is ethyl acetate, obtainable from any drug or chemical supply house. Carefully cut out the necessary parts from 3/16″ or ¼″ sheet plastic and then dip the edges to be joined in cellulose acetate. A photographic tray of the enamel, glass or stainless steel type is excellent for holding the ethyl acetate. Ethyl acetate is explosive. As the fumes are toxic, the work should be done under a hood or out-of doors. After the edges have been dipping in the ethyl acetate about 5 to 8 minutes, join the edges and allow to stand. You will find the edges soft so that each piece will flow into the other. It is best not to work in a damp place or when humidity is high. It takes but a short time to construct a case. Note that no cement is used, and that no heat is required to join the edges. The solvent (ethyl acetate) dissolves the edges so that the molecules of the two acetate plastic sheets intermingle when placed together and harden when the ethyl acetate evaporates. Now remove the instrument from its metal case and re-install it in its new plastic case.

If lucite or plexiglass plastic is used a superior but more difficult job can be done. The solvent used for these is di-glycol ethylene. It is also sold under various trade names by plastic supply houses. Cylindrical cases for instruments can be made from plastic tubing obtainable from plastic supply houses.

It is not wise to attempt to transfer electrical instruments into plastic cases. Pressure and gyro-instruments are the easiest to place into plastic cases. The plan below will give the name of each instrument on the panel.

1. Magnetic compass.
2. Pilots direction indicator (from Bombardier).
3. ILS instrument landing glide path and localizer indicator.

Continued on Page 185

Some Important Principles in Physics Which Require Demonstration in Chemistry*

RAYMOND S. TOBEY
Girls' Latin School, Boston

IN DISCUSSING physical principles which require demonstration in chemistry, I am sure that chemistry teachers would readily subscribe to the following propositions:

1. Our pupils cannot grasp the significance of many chemical observations unless they understand certain physical principles.
2. Few of our pupils have studied physics.
3. The teacher is apt to forget that physical principles that seem obvious to him are not so to the pupil and require demonstration and discussion.
4. The choice of experiments to be demonstrated should be dictated by the immediate needs of the pupils in the interpretations of observations in chemistry.
5. The experiments chosen should be simple and readily understood.
6. The emphasis in the chemistry class will often be different from that in the physics class. In general, more stress will be laid upon the qualitative treatment of the principles than on the quantitative determinations of the physics class.

It is important for the pupil to become thoroughly familiar with the units of the metric system most commonly used in the chemistry laboratory. Such familiarity is not gained by memorizing a table in the book, but by making measurements of length, volume, and weight in the laboratory.

IN MOST chemistry classes the pupil is called upon rather early in the year to deal with oxygen and the air. Unfortunately, gases do not seem as real to the beginner as the teacher often supposes. In fact, most pupils would be inclined to say that a bottle filled with air is "empty." It helps to make clear that a gas is a real substance if an inverted tumbler is thrust into a battery jar filled with water in such a way as to enclose a floating cork to show that little water enters the space occupied by the air. Again, the pupil is surprised by the gain in weight when a rubber ball, such as is used in the gymnasium class, is balanced on the scales and then additional air is pumped into the ball. After this experiment, the pupil is not slow to grasp the significance of the gain in weight of a metal heated in the air.

ALTHOUGH the pupil has lived all of his life at the bottom of a great ocean of air, he has been so used to the expression, "as light as air," that the existence of atmospheric pressure—not to mention its magnitude—is a source of surprise to him. I like to use demonstrations of atmospheric pressure in the following order: First, tie a sheet of thin rubber stretched across the bowl of a thistle tube and remove a part of the air from the tube by inhaling. Hold the thistle tube in various positions to show that atmospheric pressure is exerted in all directions. Next, tie a sheet of rubber over a bladder jar and place it on the stand of an air-exhaust pump. By all means, take time also to demonstrate the Magdeburg hemispheres. Let a pupil try raising water by sucking at the end of a 3-foot glass tube dipping into a dish of water. Repeat with a 3-foot tube dipping into mercury. If the pupil is inclined to insist that the water is drawn up by something which he calls "suction" and not pushed up by atmospheric pressure, insert a tube through one opening in a two-holed stopper, fit the stopper into the mouth of a test tube filled with water, close the second hole in the stopper with your finger and let the pupil try to raise the water through the tube.

IT IS NOT always obvious to the pupil that the same force which causes the rise of water into a tube when you remove the air also holds up the water in a tube closed at one end when it is filled and inverted in a dish of water. It is a good idea to fill a 36-inch barometer tube with water and invert in a dish of water and then fill a similar tube with mercury and invert in a dish of mercury.

*This paper was presented with demonstrations at the National Science Teachers Association, Boston, December 30, 1946.

After you have thus constructed a barometer, place it under a tall bell-jar on the plate of an air-exhaust pump and note the fall of mercury on removal of air from the bell-jar. Be sure that each pupil has practice in reading the laboratory barometer in both the English and metric systems, including the adjustment of the mercury level in the well. I also take a little time to explain the aneroid barometer and barograph. Let some pupil or pupils—there will be plenty of volunteers—take a barometer to the basement and report on any change in reading. In his absence, poll the class on the report which they expect.

While dealing with gases, try a simple experiment to show how readily carbon dioxide can be poured. If you use vinegar and baking soda to produce the gas, you can count on many of your class repeating the experiment at home.

AFTER experiments to show the lightness of hydrogen as compared with air, the pupil is rather surprised to note the rather rapid mixing of the gases when a bottle of hydrogen is inverted over a bottle of air. To compare the rates of diffusion of hydrogen and air, try the following experiment: Set up an inverted porous cup equipped with a one-holed stopper and glass tube. Insert the lower end of the glass tube so that it just passes through one hole of a two-holed stopper fitted into a bottle half filled with water. Place a second glass tube through the other hole of the stopper and extend well below the level of the water in the bottle. When an inverted beaker of hydrogen is placed over the porous cup, water from the bottle is forced out through the second tube. If this tube is equipped with a nozzle, the stream of water will spurt for a considerable distance.

We take up Boyle's Law and Charles' Law in connection with the determination of the equivalent weight of magnesium. Since the pupil is concerned with the measurement of the volume of hydrogen, we collect approximately 40 cc of hydrogen in a gas-measuring tube inverted in water and note how the volume changes when the tube is raised or lowered. We note then the marked increase in volume when the tube is placed under a bell-jar on the stand of an air-exhaust pump on removal of part of the outside pressure. Next, we observe the marked expansion when the gas is heated. By this time, the pupil realizes how meaningless the statement is that he has collected 40 cc of hydrogen unless he tells the conditions of pressure and temperature.

To illustrate Boyle's Law, we use the familiar U-tube with a confined volume of air and add enough mercury to double the original pressure. We then discuss the development of Charles' Law and the significance of the absolute temperature scale.

FOR A demonstration of the great increase in volume that takes place when a liquid or solid turns to a gas, it is interesting to boil a little water in a Pyrex test tube, closed with a cork stopper pressed in not too tightly. A small pellet of "dry ice," of course, can be used to blow out the stopper at ordinary temperatures. A small piece of "dry ice" placed in a bottle of water inverted in a pneumatic trough offers an alternate means of demonstration of the large volume of gas produced by evaporation of a solid substance.

Conversely, the condensation of steam in a closed container leaves a partial vacuum. Boil a little water in a gallon tin can that has flat walls. Remove from flame when the steam has driven out the air. Then stopper tightly and pour cold water over the can. If you prefer a longer period of suspense, let the can stand for a few minutes while the steam condenses more slowly.

Pupils are often puzzled in the experiment on distillation to observe the water collected in a test tube siphoning back into the flask, if they have neglected to remove the end of the delivery tube from beneath the surface of the distilled water. To provide for a good discussion in such a situation, boil water in two flasks; the first supplied with a one-holed stopper and a long delivery tube; the second with a two-holed stopper, a thistle tube, and delivery tube. After boiling the water in each flask for a short time, place the end of the delivery tube of each in a test tube of cold water and remove the flame from beneath the flasks.

TO SHOW the expansion of a solid when heated, we find the Cowen apparatus to be very satisfactory. After showing the expan-

sion of a solid, we take a liter flask, fill it with colored water and place in the mouth a one-holed stopper and a long glass tube so that the water extends part way up the tube. When such a flask is placed in a pail of hot water, the level of the liquid in the tube first falls slightly and then rapidly rises so that the pupil first sees the effect of the expansion of the glass and then the greater expansion of water. It is interesting, if time allows ,to use two flasks of equal capacity; one of ordinary soft glass, the other a flask of Pyrex glass of low coefficient of expansion.

The variation of the boiling temperature of water, or other liquids, with change of pressure is of such importance that it warrants demonstration. Boil water in a flask equipped with a two-holed stopper. Through one hole place a thermometer to measure the temperature of the steam and place a long delivery tube through the other. After observing the boiling point under atmospheric pressure, place the end of the delivery tube under an inch or two of mercury and note the rapid rise in boiling temperature under the increased pressure. To show the effect of reduced pressure, place a flask of moderately hot water under the bell-jar of an air-exhaust pump and remove part of the air.

FOR YEARS a favorite demonstration of boiling under reduced pressure has called for partially filling a strong. round-bottomed flask with water, boiling the water to drive out the steam, removing the flame, inserting a tightly-fitting stopper and inverting the flask. On pouring cold water over the flask, the water begins to boil and the pupil is told, or allowed to infer, that this is due to the greatly decreased pressure inside the flask.

I like to modify the experiment, using in place of the solid stopper a two-holed stopper with a thermometer in one hole and a 36-inch glass tube through the other extending to the middle of the flask. After boiling the water long enough to drive out the air from the flask, fit the stopper in tightly so that the steam will also drive out the air in the tube, then invert the flask with the 36 inch tube extending into a dish of mercury. As the steam is condensed by pouring cold water over the outside of the flask, the mercury rises in the tube and the pupil sees for himself that the pressure inside is greatly lowered. It is not unusual to produce such a good vacuum that the mercury will rise at least 29 inches on a day when the barometer reads 30 inches. Under such conditions, the water boils even though it is barely warm. Since the pressure inside is so much less than outside, it is important to use a strong, round-bottomed flask; and pupils should not be permitted to crowd around the demonstration table.

It is well to show an experiment or two on conduction of heat, including the experiment of wrapping a piece of paper about a solid metal cylinder and holding it in the hottest part of the Bunsen flame to show the effect of conductivity in keeping the paper from reaching its kindling temperature.

A FEW simple experiments on static electricity serve as an effective introduction to the study of the electron theory and the structure of the atom. In electro-chemistry I use experiments to illustrate electroplating, the electrolytic refining of copper, and the production of a storage battery by passing a current from a rectifier between two lead plates immersed in dilute sulfuric acid. In the course of a few minutes, a brown coating of dioxide appears on the positive plate; and, much to the delight of the class, the cell thus produced rings an electric bell.

The experiments suggested, while essential and fundamental, do not, of course, exhaust the list of those which may be used. I have found them interesting to the class, simple enough to be readily understood; and, most important of all, they serve to make clear important physical principles necessary to the pupil's understanding of his work in chemistry.

Our Cover Picture

Wash Tub Snow is being made by Kathleen Roan of Providence, R. I. while she shows General Elecrtic snowmaker Vincent J. Schaefer a few tricks at his own trade of snowmaking. The tub is packed in ice and rock salt, converting it into a refrigerator. By breathing into the tub she produced a supercooled cloud. Then by seeding the cloud with fragments of dry-ice she transformed the cloud into snow crystals.

Please Note: Due to a printer's error a few pages in this issue read "November" instead of "December."

Due to present paper shortages we are asking your indulgence in this error rather than to rerun these few pages.

A Laboratory Method for High School Physics

WALTER H. HELLMAN

Roger Ludlow High School, Fairfield, Connecticut

The problem concerning the status of laboratory work in the High School discussed by Morris Meister in the February (1947) issue of the Science Teacher, is one that has been troubling many science teachers for some time. While the writer agrees with the article on the decline of laboratory work and the vital need for it in the science program, he is of the opinion that there is a more fundamental reason than those given for the retrogression.

After observing laboratory work in physics for over ten years the writer is convinced that science teachers have come to realize that the traditional laboratory experiment does not produce results compatible with the time and effort expended. One of the chief aims of laboratory work is the acquisition of the experimental approach to problems. How much experimental is there in following the directions in the average laboratory manual which accompanies the usual course in High School Physics or Chemistry? I believe some educational writers have referred to it as the "Cook Book Method." The work is done in a perfunctory manner with little thought given to the process or its meaning by the student. The writer has convinced himself of these observations from the results of special tests given immediately after the experiment. Time and again these tests showed that the pupil had gained little if anything from his laboratory work.

In order to make the laboratory work more meaningful to the student a different approach was tried. A problem based on the topic being studied and capable of laboratory solution was presented to the students along with a selected list of references. Each student was required to write out the method he expected to use in the laboratory and the apparatus needed for the experiment. Before the work was done in the laboratory, various students were called upon to explain their approach to the problem. Questions could be asked by other class members and procedures would have to be justified.

The laboratory period began when it was certain that the students had a clear cut idea of what they were attempting to solve and how they were to do it experimentally. Students were encouraged to select problems of their own choosing provided they could work out the experimental solution with the apparatus available.

The results of this type of experiment have been much superior to the traditional type in pupil understanding and learning because the students devised their own solutions and then tried them out in real experimental fashion. Unfortunately all of the laboratory work cannot be put on this basis, as only those experiments with relatively simple procedures lend themselves to this method with high school students. Some experiments that are included as standard in the list suggested by the colleges are too complex in their procedures to be readily worked out by students with the average limited scientific background. However, this difficulty can be overcome to some extent by holding a discussion period before the experiment is performed. The teacher leads the pupils through the reasoning behind the process and usually performs the experiment as a demonstration. If the teacher wishes to provide greater opportunities for the better students, one or more of them may work out the process and substitute for the teacher in leading the discussion and presenting the demonstration.

While it is true that with this method the average student does not approach the work with a real experimental point of view, nevertheless he has a fairly clear idea of what he is trying to do and why he is doing it, which is more than can be said of the traditional laboratory exercise. This preliminary discussion-demonstration method may be thought of as a means of learning the proper approach to laboratory problems and in addition an opportunity to develop satisfactory laboratory techniques. The latter skill being a requisite for proficiency in the experimental approach is quite justifiable on this account.

Continued on Page 182

Scientists Want Freedom

JOSEPH SINGERMAN

High School of Commerce, New York City

US for Short

THE UNKNOWN Soldier. US for short. It was a beautiful afternoon, the fourth Sunday in October. The caisson, with its burden of honor, rode slowly, mournfully, up the avenue. Onlookers lined the route, a quarter of a million New Yorkers. They had not forgotten the sacrifice. How could they, with a scar recorded in the bosom? The loss was not in vain. Our sacrifice had served the dignity of man. We have good reason for pride. We are proud, justly proud, of our sacrifices at Bunker Hill, at Gettysburgh, in the Belleau Woods, on the shores of Normandie. Our latest sacrifice was for a precious heritage, a heritage enshrined with every sacrifice of blood made to preserve it. The Declaration of Independence. The Bill of Rights. The Emancipation Proclamation. The Four Freedoms. US for short.

On the very day, almost in the very hour, in the very city, there gathered a group of scientists. They were concerned about increasing threats to our precious heritage. Harassment of government employees, in total disregard of decencies, of basic Constitutional rights, is making it increasingly difficult to attract qualified scientists and engineers. Employees have been suspended and discharged on flimsy bases of charges by innuendo and hearsay. The employee under fire was not given a bill of particulars, and was, in general, merely informed either that he is "disloyal" or a "bad security risk." He had no right of counsel nor was there provision for appeal. His chances for reemployment outside of government work were thus all but shattered.

By a procedure paralleling the gestapo method, gross injustice is done the individual. He and his family suffer irreparable harm. The government suffers too. The federal worker is stricken with fear lest he be seen in the "wrong" company, or venture an opinion not in conformity with the state of mind of the investigating body. Basic constitutional rights are swept aside. Thought control is imposed by intimidation. Freedom of speech and of association are left as mere words, like bones without flesh. In the words of former Assistant Attorney General Thurman Arnold, a police state atmosphere prevails.

Men of Letters Join Forces

THE MEETING of scientists was not alone in protesting the current wave of abridgement of civil rights. Their's was one of a number of panel meetings. There were panels on literature, film, radio, press and advertising, education, law, theatre, music and art. It was the occasion of a Conference on Cultural Freedom and Civil Liberties called by the Progressive Citizens of America (PCA).

The Conference, I would say, was dedicated to a struggle to preserve that for which the soldier had fought and died. Has it not been said that eternal vigilance is the price of liberty?

This gathering of eminent men of science, of the arts and letters protested against the activities of the House Committee on Un-American Activities, the so-called Thomas-Rankin Committee. They were disturbed by the effects of the President's loyalty order of last March by which federal employees were being intimidated and discharged in total disregard of the Bill of Rights. They were agitated by repeated rumor headlines about atom bomb spies. The fiction of atom secrets, which is fostered in the minds of the public

in order to help grease the ways of reaction and suppression, was thoroughly exposed. They deplored curtailment of the free international interchange of science personnel and of scientific information, the adrenalin of scientific progress in the past.

The tenor of the Thomas-Rankin Committee was illustrated, last summer, by its Chairman, J. Parnell Thomas. In writing about Dr. Edward U. Condon, renowned American physicist and Director of the United States Bureau of Standards, Congressman Thomas accused him of responsibility for alleged leakage of atomic "secrets" from Oak Ridge which, he revealed, was infested with "reds." The subsequently established fact of the tenuous nature of the allegation did not erase the false alarm widespread by the scare headlines which grew from these irresponsible statements. Condon was said to have been in charge of patents. It is amazing that a very influential member of the United States Congress did not know that the Bureau of Standards has nothing to do with the granting of patents. This same Congressman accused Dr. Condon of having a foreign born wife. Neither the irrelevance nor the inaccuracy of this allegation served to deter the Congressman from the apparent determination to smear a well-known scientist.

THE disgraceful procedure of the un-American Committee is not confined to smearing movie script writers and actors and to using implied threats and inuendo to dictate what kind of pictures the American public may be permitted to see. Its shameful treatment, last year, of Dr. Harlow Shapley, Director of the Harvard Observatory, will not be forgotten.

The Committee permits to be entered into the record loose charges of disloyalty and membership in so-called subversive organizations. It accepts as testimony hearsay, inuendo and personal prejudice. "Accused" persons have no right of cross-examination, nor are they afforded an opportunity of self defense. They are compelled, on pain of being cited for contempt, to answer questions placed by the Committee. Presumably, the Committee is a fact finding committee, but it is well recognized that, in effect, it acts as prosecutor and judge combined. While Congressional immunity protects Congressional members and investigators from suit for libel, their sweeping, though loose charges make the newspaper headlines.

In this way the Committee is largely responsible for the current wave of "anti-red" hysteria, a reaction aimed at every last vestige of liberal or progressive thought, an atmosphere in which free science would perish. Nazi-like violence, in the very shadow of the Liberty Bell in Philadelphia, has already shocked the nation. If they succeed in intimidating writers today, education and scientists will be their victims tomorrow. This Committee's files are consulted in determining the "loyalty" of Federal employees. In its hearings, the Committee seeks and encourages testimony, be it hearsay or personal prejudice, to bolster its own ideas of what is subversive or un-American. And the record shows that its own ideas are an arrogant travesty on the fine heritage of American freedom. The un-American Committee itself is, in the words of the Detroit *Free Press*, "the most viciously un-American thing in America today!"

Loss of employment, and professional stigma attached thereto, is not limited to Federal employees. Particularly for scientists, it has reached into private institutions and universities. There is the heartrending story of the couple who traveled across the country and bought a house near a plant, operated by the General Electric Company, where they were promised employment as physicists. After many months of stalling, they were informed that they had not been cleared by the government. They were refused employment even in work having no connection with government contracts. And, it was only after intervention of scientific societies that they were given any kind of employment. It was reported that they were personally friendly with a union leader during a strike in 1946 of United Electrical workers, and the husband happened to be a classmate, 30 years ago, of one of the recently accused Canadian scientists. The fact that this Canadian scientist was acquitted did not seem to make any difference.

On another occasion, some Federally employed biologists were grilled by the FBI.

Continued on Page 182

Chats With Science Teachers

HANOR A. WEBB

Department of Science Education, George Peabody College for Teachers, Nashville, Tennessee; Secretary National Science Teachers Association

Beginning with this issue we are introducing a series of "Chats with Science Teachers" by Dr. Hanor A. Webb. The first of the series to follow includes the following:

Chats with Science Teachers II—"Science and Poetry"

Chats with Science Teachers III—"Science in the Bible"

Chats with Science Teachers IV—"Science and the Imagination"

We believe the thoughts that Dr. Webb brings to you from a rich experience in science teaching will be exceedingly helpful.—Editor.

"Meet the New Word"

How graceful are you, my fellow science teacher, at introductions?

If a visitor who *might* be important came to your class, would you merely mumble his name. Or would you learn who he was, where he was from, and what he meant— then tell the class what you had found out so that they, too, would know his name and fame?

Would you mutter, "This is Musta Murse Musta, and won'tcha say sumpun, Musta Musta?" Or will you give a clean introduction of "Doctor Morris Meister of New York City, Principal of the Bronx High School of Science and President of the National Science Teachers Association, who has agreed to speak to us."

Every teacher has the duty to enlarge the vocabularies of students. Not even the English teacher has as many visitors, in the form of new words with important meanings, as come to your science classroom. How well do you make the introductions?

The acquaintance of strange words, like that of strange people, is made by the use of familiar phrases. When this is well done they are no longer strangers. There are three chief ways to match the new words of science with old words—to go from the known to the unknown. Here they are:

Synonyms. These are words of comparable —though not exact—similarity in meaning. Examples: *synonym*—"substitute word"; *concept* — "idea"; *I. Q.* — "intelligence"; *enzyme*—"ferment"; *hybrid* — "half-breed"; *velocity*—"speed." Select synonyms with care, being sure they are (a) quite well known, and (b) will be friendly with the new word, having much in common.

If you are writing something for student use, put the synonym in parentheses after the new word, thus: *Heavy oil may become viscous (thickened) with cold.*

Antonyms. These are the more familiar opposites of the new words. Examples of words and opposites are: *antonym*—"synonym"; *fallow* — "cultivated"; *euphony*—harshness"; *purebred*—"mongrel"; *limpid*—"viscous." Antonyms must be selected with even greater care than synonyms, for opposites often lack common understanding as to whether they are really on the far ends of the same see-saw.

If you use antonyms in writing, put them in parentheses thus: *Although heavy, mercury is a very limpid (opposite of viscous) liquid.*

Derivations. Scientists rarely invent wholly new words, although advertising men and jitterbugs do so with abandon. The dignity of science is upheld by many classic pillars, hence modern words come appropriately from ancient languages. Every good reader of English knows a lot of Latin and of Greek, some Arabic, and a little Anglo-Saxon. Calling attention to the original meaning of familiar syllables helps to explain many a new word. Examples: *atom*—Greek, "uncut"; *chlorophyll*—G., "green leaf"; *colloid*—Latin, "like glue"; *enzyme*—G., "in yeast"; *ion*—G., "traveler"; *molecule*—L., "little mass"; *ovary* G., "egg basket"; *pollen*—L., "fine as flour"' *silo*—G., "pit for corn"; *stratus*—L., "in layers"; *terra cotta*—L., "cooked earth."

Derivations are by no means definitions; they are chiefly aids in remembering a new word because of interest in its ancestry. You do not have to be a classic scholar to use these derivations in your introductions. The "big dictionary" gives the information for every word whose great-grandfather came over to this country on the Mayflower, or later.

In writing out derivations for your students, use parentheses in this form: *More than a dozen ingredients (Latin, "things that walk in") are needed to make a fruit cake.*

Integration Tests

RALPH B. DeLANO

Memorial High School, Boston

THIS TEST deals with common things which form part of the environment of nearly every person. Although the questions themselves may seem to have little significance, failure to answer them reveals lack of practical knowledge in important scientific fields. Do not blame the test if you cannot pass without the use of reference books. Your failure simply indicates that you have not had the type of terminal course in integrated science which is essential for those who do not continue their education beyond the high school. Criticism is invited.

1. Discuss in full the value of special breathing exercises practiced for the purpose of increasing the capacity of the lungs.
2. Draw a simple diagram illustrating the proper distribution of fresh coal which has just been placed on a furnace fire. Give your reasons for the distribution which you recommend.
3. Is it correct to say that a concentrated solution of acetic acid is a weak solution? Explain your answer.
4. When is a radio set said to be in alignment?
5. If you raise your hands from the steering wheel of a moving automobile, the front wheels, when slightly deflected, tend to return to their normal position. What is the cause of this action?
6. In what three ways may the leaves of a spruce tree be distinguished from the leaves of a balsam tree?
7. What five of the twenty apparently brightest stars in the universe are plainly visible during the first few hours of darkness on a July evening?
8. What precautions are taken to prevent the collapse of the range boiler or hot water storage tank found in most kitchens?
9. For what purpose is the ventilation of an ordinary room usually advisable? Explain in full.
10. What four valuable components of vegetables are most easily lost by cooking?
11. State three ways in which a chickadee may be distinguished from a nuthatch.
12. What is the difference between a simple fracture and a compound fracture? What precaution should be taken when it is necessary to move a person who has a fracture?
13. What is the phenol coefficient?
14. Explain the difference between the positive and negative camber of an airfoil?
15. What common plant produces the white drupes which may often be seen along the side of the road during the month of August?
16. What is the average normal systolic blood

Continued on Page 194

Exercises in selecting synonyms, antonyms, and in looking up derivations, give excellent practice in the written work of a science class. Don't overdo the assignments, however.

Pronunciation. When you announce your guest, speak the name distinctly and correctly. Dr. Meister's name rhymes with *high stir*, not *sister*, or *Easter*. Unless a "high stir" is something naughty, it makes no difference what it means—the words are pronounced the same by everybody.

If you are writing a new word and believe that your students will mispronounce it (which will be often), devise a phonetic pronunciation for a parenthesis to contain. Do not bother with the old-fashioned diacritical marks—few students of today have learned them. Use capitals for the accents and spell the syllables as they sound. Your sentence may read: *The aurora borealis (aw-ROW-rah bow-re-AL-iss) is a strange phenomenon (fee-NOM-ee-non) of the Arctic air.*

Visiting words will be strangers only once in your science classes if you introduce them effectively and gracefully—as you would pay a similar courtesy to Doctor Morris Meister, President of the National Science Teachers Association.

Science Clubs at Work

Edited by MARGARET E. PATTERSON
Secretary, Science Clubs of America

• A department devoted to the recognition of the splendid work being done by science club members and their sponsors. Material for this department, such as student made projects; demonstrations and posters; outstanding club programs; state and regional meeting announcements; should be sent to Miss Patterson, Science Clubs of America, 1719 N Street, N. W., Washington 6, D. C.

A Science Congress as a Community Project

MADELINE FRINK COUTANT*
Hartwick College, Oneonta, New York

THE PEOPLE of Oneonta, New York are not waiting idly while others tackle the problems of the Atomic Age.

We, the inhabitants of this city of about 12,000 are convinced that an understanding of science is essential for the solving of many problems of this new age. We are going all out to learn about science—and to encourage our children to understand it.

The mayor summed up our concern over sharing in the world's problem in his 1947 *Science Day Proclamation.*

Science Day Proclamation

Today we stand at a crossroads. Both roads are dependent upon using scientific knowledge as a weapon. In one direction lies the weapon of destruction so horribly demonstrated by the atomic bomb. In the other direction lies the weapon that is the hope of mankind in his fight against disease, low standards of living and intolerance bred of ignorance.

The arrival at the end of either of these lies with the highly skilled scientist. The real responsibility, however, for determining in which direction we travel lies with the peoples of the world. In the final analysis this responsibility falls on each individual; the responsibility lies with us, the people of Oneonta, as much as with anyone.

We cannot hope to deal with the problem intelligently unless we understand what the scientists of today are doing, unless we try to appreciate and mold their aims. Statistics show that America is headed for a serious shortage of scientists. This can be corrected by a high level of public interest in their work.

It is with this in mind that I designate Saturday, May 3 as Science Day in Oneonta.

A. F. CARSON, Mayor.

Mrs. Coutant visits James Howard, 1946 Congress winner, in his home laboratory where he tests the effect on mice of cystine he extracted from human hair salvaged from local barber shops.

Wanted: More Scientists

A RECENT and forceful warning of the dangers that face our nation as a result of a serious shortage of scientists appears in the REPORT TO THE PRESIDENT by John R. Steelman, Chairman of the President's Scientific Research Board.

*Mrs. Coutant is Assistant Professor of Chemistry at Hartwick College, Oneonta, N. Y. She is director of the Oneonta Science Congress and was responsible for starting it in 1938 when she was a teacher of chemistry in the local high school.

A Congress entrant explains his work to judges before assembled spectators in a gymnasium converted for a day into a laboratory.

Oneonta is proud htat it has already helped to relieve this shortage. Since 1938 it has held a one-day Science Congress each year* to locate and help students of real promise in this area to further their education in science. This event has also presented new developments in science to the public by a display of the work of boys and girls interested in careers in science.

Some of the early winners finished college in time to do wartime research work on poison gases, rocket explosives and antiseptics. The winner of our first Congress, George DeLa-Mater, an organic chemist, is now fniishing two years at the graduate school of Harvard on a Rockefeller fellowship awarded on the basis of his war work.

Entrants Invited from Surrounding Area

Plans are now underway for the Seventh Science Congress to be held May 1, 1948. Its theme will be "Science for Everyone."

Two hundred high schools from five surrounding counties have been invited to enter competitive exhibits and demonstrations by boys and girls who want to be scientists.

As usual a Photographic Salon will be held and high school students are urged to show their work on any subject.

Non-competitive entries are also invited from elementary schools, colleges and scientific industries.

Community Planning Necessary

Planning for the Congress is a community affair here. Hartwick College, sponsor of the event, goes into it whole-heartedly from President Henry J. Arnold and the faculty down to the incoming freshmen, many of them "Congress graduates."

Students, with the counsel of faculty advisors, serve on many needed committees.

Members of the college groups: Langmuir Chemical Society, Biology Club and Nursing Club, are active in the planning and also prepare exhibits of college science work especially for the young visitors.

Awards Are Donated

AWARDS for the best exhibits and demonstrations are donated by colleges, industry, the press, civic groups and local businessmen. The awards are Hartwick College scholarships, all-expense trips to places of scientific interest, books, magazines and scientific apparatus. All honorable mentions receive certificates.

Best four in the Photographic Salon receive free trips to the plant of Ansco at Bingham-

Edward Clark, winner of the $1,200 scholarship to Hartwcik College in 1947, explains his models of crystal systems.

*Curtailed during war years because of transportation restrictions.

One partner explains the operation over the loud speaker while the other dissects a cat before the Congress audience.

ton while a group of biology winners are conducted through the Lederle Laboratories in Pearl River.

Noted Scientists Attend

The Congress officially opens with a Science Banquet the night before the big day. At the 1947 banquet the guest of honor was Dr. James B. Sumner, 1947 Nobel Prize Winner in Chemistry, of Cornell University, who had just returned from his trip abroad and reported on "Sweden and the Nobel Ceremonies."

Gymnasium Becomes a Laboratory

When the crowd gathers early the next day they find the gymnasium transformed into a huge laboratory through the cooperation of many community groups. Churches have loaned tables and chairs. The gas and electric company and the plumbers have been at work so that each entrant sets up his exhibit or demonstration at an individual "lab desk" with gas, electricity and running water.

From 10:30 to 4:00 the "laboratory" becomes an arena with youthful speakers telling of their work from the floor while hundreds of spectators listen from bleachers and balconies.

The judges occupy a prominent spot in the arena and are free to question the speakers. Judges in 1947 included Dr. Victor Schmidt of Cornell, Dr. C. Lee Huyck of Columbia, Dr. Paul Gleason of Colgate, Dr. Gertrude Evans of Wells and Dr. Hannar Yager of Oneonta State Teachers College. The Photographic Salon was judged by James Thomas, APSA, ARPS, of Oneonta.

At various times during the day technical films are shown and demonstrations of non-competitive exhibits are given.

The climactic event of the full day comes late in the afternoon when the awards are made. School spirit runs high and winners are wildly acclaimed for the honor they earn for themselves and for their school. "Semi-finals" in several districts this year will increase the opportunity for participation.

Educational Benefits

THE TEN years of the Oneonta Science Congress have brought benefits to students and

Head table at the science banquet before the 1947 Congress. L. to R.: Dr. James B. Sumner, 1947 Nobelist, of Cornell University; Dr. Henry J. Arnold, Hartwick College president; Mrs. Madeline Frink Coutant; Dr. Herbert Grosch, Columbia University; and Robert Osthoff, student chairman.

teachers, educators, and the public in general.

High school students and teachers look forward to it as a test of their scientific knowledge and techniques. They learn to appreciate that originality, accuracy, imagination, persistance, careful observation, keen analysis and organizational ability are necessary to make a creditable appearance at this event. These same qualities are essential to a career scientist.

Educators acclaim the Congress for its success in giving science a glamour that is usually associated with extra-curricular activities like athletics. They agree it provides guidance by acquainting boys and girls with the requirements of a career in science.

The public appreciates this chance to keep up with new developments in science. The presentations are usually not too technical for comprehension even by those whose technical training is limited. And the public enjoys the spirit of keen competition among the youth entrants.

Owen C. Becker, lawyer and past president of the Oneonta Board of Education, has called the annual affair "one of the most significant programs in our area."

With such support and community cooperation the Congress will continue to inspire the boys and girls of Oneonta and the surrounding area and help young and old to understand some of the problems of the Atomic Age.

Our Science Club Editor

This journal is most fortunate in having as its club editor, Miss Margaret E. Patterson, Secretary of Science Clubs of America, one who is in close contact with the work of youth in the science field throughout the United States.

Miss Patterson did not come into her present position by accident. She has a background of thorough training in science, having a major in biology with all her pre-medical training done; and a minor in English. She received her bachelor of science degree from the University of Missouri and then studied for the masters degree at Columbia University, New York City.

Her career started with the teaching of science—general science, biology, and chemistry—in the schools of Arkansas and Missouri. In the latter state she became actively associated with the work of the newly formed Missouri Junior Academy of Science.

Margaret E. Patterson

In 1938 she accepted a position with the American Institute of the City of New York to expand their local experience with science clubs to a nation-wide basis. In 1941 she accepted a position with Science Club Service when the science club movement was taken over from the American Institute and has helped in the growth of cooperating clubs from 700 to over 14,000 with a total membership of over one-third of a million boys and girls. She is responsible for the operation of Science Clubs of America and for conducting the annual Science Talent Search, sponsored for the organization by the Westinghouse Electric Corporation.

Her editorial work is extensive. In addition to editing our Science Clubs at Work department in *The Science Teacher* she is responsible for the *Science Talent Searchlight* (magazine), the *SCA Sponsors' Handbook*, and a number of memos to SCA cooperators.

If you are interested in science clubs, you will want to keep in touch with Miss Patterson and her work.

Dissolving the Walls of the Classroom

Science as a Training for Citizenship

MARTHA E. MUNZER

Fieldston School, New York City

FOR YEARS, Science teachers have been aware that theirs is the task of developing certain skills and habits of thought in their students. At Fieldston, we have always believed in the laboratory approach—the "learning by doing." We would like our students to take into the laboratory a desire to find out what actually happens, an ability to weigh evidence and draw conclusions, and a willingness to modify these conclusions in the light of new evidence. We hope that direct practice in the scientific method will prove useful to all our students, whether or not they go on in the study of science.

More recently it has been borne in upon us that this is not enough, that indeed the teaching of science is rich in other and equally vital possibilities. Science teaching can and ought to be used as training for citizenship. Presumably, many of our students will not be future scientists but all will have to play a part in the community, and all will be directly or indirectly responsible for the uses to which science is put. It is for this reason that we at Fieldston have been attempting to "dissolve the walls of the classroom" and to bring our students face to face with the realities of our technological culture.

The first and perhaps the easiest step is to give our students the opportunity to see at first hand and to understand, at least in part, the miracles which science has performed. Exhibits in museums and fairs are helpful when the student already has a background of knowledge on which to build. These exhibits are interesting and often stimulating, but because they are detached from life they are devitalized, and we as educators must look elsewhere to bring our students into contact with science in action, science as it impinges directly on the lives of human beings.

THE RESEARCH laboratory supplies one of these vitalizing experiences, for here the students may begin to glimpse the possibilities of the scientific frontiers. Mr. Augustus Klock, head of our science department, has through the years maintained a lively contact with our graduates, some of whom have attained eminence in various fields of research. It is thus that our seniors have taken trips to the Boyce Thompson Institute for Plant Research, the Rockefeller Institute for Medical Research, and two research laboratories at Medical Center. What warming experiences to see men of science quietly at work—to have them take time to explain to us in simple terms what their researches are about. We learn how closely interrelated are the findings of workers in the many fields of scientific inquiry, where artificial boundaries of race or nation are discarded in the mutual search for scientific truth, and the increasingly successful attempt to liberate people from pain and disease.

These experiences revealed one of the vistas which might lie before us were it possible for men of good will truly to work together for the well-being of their fellows. As we walked out into the streets we were confronted with headlines of *Atomic Energy and the Atom Bomb*—with the all too vivid paradox of the inventions of science which might have blessed mankind, used or misused to torture and destroy. Large questions were forming themselves in our minds. "Does this have to be? Who or what is responsible? Can we do anything about it?" Large questions to which there are no ready answers, but at least we make a start when we put the query and begin to search.

IN STILL other areas we are beginning to develop the "seeing eye." By means of field trips, we have been able to visit mine and quarry, farm and factory; not just a Cook's Tour visit, but an outgrowth of preparation and study. We take time to learn something of the geology and history of the region we are to visit, as well as the human problems that will confront us.

Spending hours in the dark and dripping underground city which is a coal mine is quite

different from reading about it in a book. If you have seen a man crawling on his belly to dig coal from a vein no more than eighteen inches high, if you have heard the miners tell of the explosion and cave-in which took the lives of seventeen of their fellow-workers, if you have seen barren shanties at the foot of huge mountains of refuse where pallid children dig for bits of burnable stuff, you are not likely in the future to be indifferent at the mention of the word "coal". You will be forced to ask once more, "Are such conditions necessary? Can anything be done?" If, when you are studying metallurgy, you visit an iron foundry or steel works with your eyes and ears open, you will, in all probability, remember something about the men whose lives are made or broken by the molten metal, long after you have forgotten formulas and chemical equations.

FIELD TRIPS, of course, became extremely difficult to arrange during the war and immediate post-war days, but we are hoping and planning to reestablish and reenforce our program. In the meantime, we have had another type of experience and an unusual one for the science department of a school. Fieldston has for many years believed in the values of a Festival as a unifying and invigorating experience in the life of the school. For the past two years our science department has had an active share in the production of the Festival.

Two years ago the general topic was "Freedom," and we took as our special project "Science—for Freedom or Slavery." We tried to show in various ways, by exhibits, posters and demonstrations how science may be used to free or enslave mankind. Nitrogen, sulfur, and chlorine—these elements were used to show the duality of our choice, by emphasis on the peaceful and destructive purposes to which these elements and their compounds could be put. We asked the question again and again in all kinds of ways: "What is the answer to be? Will the Doctor of the future keep a peaceful world well or patch up the victims of war? Will the pilot of the future drop bombs on the enemy or use the airways for errands of peace?" We tried to point out that the answers to these questions were up to us, the teacher, the student, the parent, the community.

Our Festival of last year was on gay note, its theme being Alice in Wonderland. "Curiouser and curiouser" were the things that happened to Alice as she entered the Wonderland of Science. About thirty students worked on this part of the Festival. They were divided into various committees according to their special interests and talents. The Art Committee enlivened the lab with quips in the spirit of Lewis Carroll. "Have you heard of the romance of Nickelous Nitrate and Ethyl Alcohol?", said Alice. "No," said the Carpenter, "but I have heard that nitrates are lower than day rates!" The magicians of course had a Roman holiday with their safe. but not too sane explosions and tricks. Some of our most talented students conceived the idea of having Alice undergo a series of transformations in size, using these differing sizes as ways of illustrating some important physical laws. Exhibits were set up representing Alice from the time she sat on an electron to the time when she was huge enough to swing from a star. At normal size, gravity, of course, was the principle which governed her motion, and the exhibits showed the various other forces that would come into play for objects much smaller or larger than ourselves. What a wealth of "learning" went into the designing and setting up of these exhibits! Our final contribution was a "show" by lantern slide and running commentary, trying to bring home once more the possibility of a Wonderland that science could create for everyone. "Somehow we can't quite understand how science can really forge ahead without people understanding other people and caring about each other, trying to make a world Wonderland, rather than a Wonderland belonging to a few."

THROUGH experiences such as these, we science teachers are beginning to realize that we, like others, can attempt, along with our students, an education for citizenship. It seems to me, we have a peculiar privilege, and responsibility. One of the ablest of Britain's young scientists, Lancelot Hogben, has put it this way: "The claims of science in the education of the citizens extend far beyond a passing familiarity with the way in which society at present uses the knowledge available for

Continued on Page 186

Audio-Visual Aids

EDITED BY CHARLES R. CRAKES

The editor of this department will attempt to bring before the readers of this publication the latest articles written by science teachers who are making effective use of various forms of audio-visual teaching materials. He will also endeavor to present a cross-section of educational opinions on audio-visual aids he may gather in travelling about North America.

High school science teachers will no doubt be interested in the following study made by Mr. R. A. Bullington, Department of Science, MacMurray College, Jacksonville, Illinois. The editor suggests that similar studies be conducted in various parts of the nation. We will be most happy to publish the result of such surveys which apply to the field of science.

Within recent months, there has been a steady increase in the production and distribution of excellent audio-visual materials in the Science Field. Inquiries directed to the editor of this department will bring you a list of some of these new materials and their sources.

Mr. Robert Bullinton serves as instructor of the Foundation of Science Course at MacMurray College, Jacksonville, Illinois.—C. R. Crakes.

Do You Use Audio Visual Aids?

R. A. BULLINGTON

Department of Science,
Macmurray College,
Jacksonville, Illinois

HOW EXTENSIVE is the use of audio-visual aids materials, particularly motion pictures, slides, and film strips in high school science classes? How effectively are they used? What do the students think of the procedures used by their teachers?

To secure partial answers to these questions, the writer has conducted a survey of his students. One hundred thirty five students in a science survey course entitled "Foundations of Science" were asked to fill in a questionnaire. Most of these students are college freshmen, majoring in subjects other than science.

Of these students, sixty-one per cent attended high schools in Illinois, while the remainder represent schools from fifteen other states, mostly in the mid-west. It is interesting to note that five of these students have had no science in high school, twenty-eight have taken only one course, sixty have had two courses, thirty-four took three courses, and eight have finished four courses.

Sixty-four per cent studied general science; fifty-eight per cent, biology; forty-seven per cent, chemistry; and eighteen per cent, physics. A scattered few have taken courses in botany, zoology, physiology, and health.

Use of Audio-Visual Aids

THE RESULTS of the survey do not show a universal use of motion pictures. Only fifty-six per cent of all science teachers have made any use of them. It was found that fifty-four per cent of general science teachers, sixty-three per cent of biology teachers, sixty per cent of chemistry teachers, and fifty per cent of physics teachers have used motion pictures in the classes represented by these students.

3¼ x 4 slides, film strips, and 2 x 2 slides were even less generally used. Twenty-nine per cent of the teachers have used these aids. They were used in twenty-three per cent of the general science classes, forty-one per cent of biology classes, twenty-five per cent of chemistry, and thirty-three per cent of physics classes.

It was indicated that in forty-two per cent of the courses, the teacher used some form of projected audio-visual materials as a regular class procedure. In fourteen per cent of

all courses, the students felt that these aids were used only to entertain or to consume time. In seventy-six per cent of the classes where such materials were used, the students agreed that these aids were a definite help to them in understanding the subject matter.

Students Like Them

WHEN audio-visual materials are well chosen and properly used, students are enthusiastic about them. The following is a summation of students' reasons for liking movies and still pictures:

1. The students gain a clearer understanding of the subject matter involved and can remember it longer.
2. Motion pictures, etc., can go far beyond the limitations of the local laboratory equipment.
3. Audio-visual aids supplement the text and make it easier to understand.
4. There is greater student interest, for a variety of methods are used, and the student is relieved of the monotony of continuous lecture.
5. The inexperienced or inadequately trained teacher is aided in subject matter presentation.
6. Science is brought up-to-date.
7. A greater appreciation of science is fostered.
8. Scientific principles are made clearer.
9. Such mysterious things as internal human anatomy, the operation of a gasoline engine, and the behavior of molecules are made understandable.

Good Methods

Here are methods of presenting audio-visual materials used by science teachers that the students liked:

1. Materials were carefully chosen and well-timed. There was a purpose in every showing.
2. Students were prepared for the showing of material. It was correlated with the subject matter unit. Its purpose was explained.
3. Interesting discussions followed the presentation. Students were encouraged to ask questions.
4. More than one showing of the material was given if the difficulty of the subject warranted repetition.

The micro-projector is a useful aid in the lecture course in biological science.

Student Criticism

THE STUDENTS presented a number of criticisms of the methods used by their high school teachers. It must be remembered that the conditions described below are not found in all schools, but they are prevalent enough to merit the attention of science teachers. What follows is a composite picture of the criticisms offered.

1. Audio-visual materials were poorly chosen. They were sometimes unrelated to subject matter, too elementary or too technical, too lengthy, or out-of-date.
2. Materials were not explained or discussed in class, but were merely shown without comment. Students were not expected to take any notes, and questions on the subject matter were not included in tests.
3. Movies were used to entertain or pass time.
4. Audio-visual materials were used infrequently.
5. The school was poorly equipped and methods of instruction were old-fashioned and ineffective.

Why No Motion Pictures?

There are a number of reasons why teachers do not use audio-visual materials in their science classes. It is beyond the scope of this article to deal with the correction of these difficulties, but it should be pointed out that it is quite possible to overcome each of them wherever it exists.

1. Lack of equipment or insufficient funds to purchase equipment has been a common

Continued on Page 190

Adaptable Equipment for Use in General Science

LOUIS T. COX

State Teachers College
Towson, Maryland

(Concluded from October issue.)

II. Light

A FEW ideas about the nature of light waves are easily shown using a length of clothes line. With the clothes line held at one end, snap the other to produce waves that travel to the held end. Be sure to produce some waves in the horizontal and diagonal planes to show this analogy to one theory of light transmission.

A pair of polaroid sun glasses are more useful. Remove one lens from a pair of polaroid glasses (or use two pair of glasses) and in front of a light source, rotate one lens in front of the other. Note that before any rotation, maximum light gets through the two lenses, but at 90 degrees rotation in either direction, hardly any light gets through. One explanation is that the polaroid material is a submicroscopic grill of slits in one direction only. These slots block all waves of light not vibrating in the plane of the slits. So, if the slits of one lens are turned at right angles to the slits of the other lens, any waves not blocked by the first lens will surely be blocked by the second.

White light can be separated into the colors of the rainbow by use of one of the prisms now being sold widely as war surplus. A rectangular aquarium full of water will do the same. Place the prism in a strong beam of sunlight or in the light from a slide projector in a darkened room. Then move the prism around until a "rainbow" is thrown on a convenient part of the wall or ceiling. The band of colors will be more definite if the ray of light is allowed to enter the prism only through a narrow slit in a piece of cardboard.

ALL THREE kinds of mirrors—plano, convex, and concave—are available usually in some of the pupils' homes. With a plane mirror, a breadboard for a base, some modeling clay for support, some pins, thread and a protractor, angles of incidence and reflection can be measured and compared easily. Periscopes and "split-image" rangefinders depend entirely on these principles. The convex mirrors used for auto rear vision or for decorative purposes in the home are very satisfactory for showing the type of image convex mirrors produce. With a concave mirror of the type used for shaving or make-up purposes, the kinds of images produced by these mirrors can be studied. A black arrow painted on the end of a 100 watt frosted glass bulb can be projected on the wall or other screen in a darkened room. The bulb should be shielded on the sides away from the mirror by placing it in a long can or oatmeal box. The relationships between focal length, distance to light source, and to screen are readily shown. Be sure to discuss such applications as the reflectors for flash lights, auto headlights, search lights and projectors, and reflecting telescopes.

A large variety of lenses are available in magnifiers, reading glasses, linen counters, cheap spectacles, cameras, telescopes, and opera glasses. The toy telescopes and opera glasses may include some concave lenses, but the rest of those mentioned are convex. Stationery stores, art stores, camera shops, and toy stores carry many of these. If a special size or type lens is needed, optical supply dealers (see phone book, classified) often sell lenses with slight defects for 25 cents each.

CONCAVE lenses can be mounted on a board or table by use of modeling clay and with a candle or other light source, the images and focal length relationships can be studied. But, why not try applying some of these principles in building a projector or a 100 power telescope?

A 3″ x 4″ slide projector, very satisfactory for showing slides made by pupils to illustrate reports or to photographic slide series from library collections, is not hard to build. The main construction is a wooden box, which must be not less than 5″ x 5″ x 12″ inside dimensions. To the center of the blackboard, screw a cleat type socket and insert a Mazda 150 watt projector flood bulb. In the center of the front board of the box, cut a rectangu-

lar hole 2⅞" x 3½" using brace and bit to bore holes at the corners and a keyhole saw to cut the sides. On the outside of this hole, form horizontal guides out of layers of cardboard strips so the slides can be pushed in front of the hole. On top of the box, form a guide of wood for the 15" x 1" x 1" focusing bar. To the front of this bar, nail the lens board with hole bored to hold the lens in front of the center of the slides. Any cheap lens of about 9 or 10 inches focal length will do. To prevent loss of light, tack a bellows folded accordion fashion from a brown paper bag between the front board and the lens board. Bore or saw ventilation openings in the back parts of the side boards and finish with a coat of flat black paint. Perhaps the boys in the class can devise a better model than the one described here.

A 100 POWER celestial telescope has a very simple optical system, a long focal length objective lens and a short focal length eye piece, both convex. The tube is formed from two cardboard cores from the center of bolts of cloth, spliced together with tape and cardboard. The objective lens is a spectacle lens, of focal length an inch or two longer than the tube (about 80 inches?) Cement and tape the lens to one end of the tube. The eyepiece lens is a linen counter lens of ¾ inch focal length (shorter makes more power). Cement this lens to a disc of cardboard and cement the cardboard to the end of a short tube that slides inside the main tube. With this telescope and a steady support for it. you can easily see craters of the moon, moons of Jupiter, and the rings of Saturn.

III. Energy

WE CAN adapt even some materials from the nursery in this study of energy. Use a pyrex baby bottle and cork next time instead of the test tube and rubber stopper to show the effect of steam pressure. You'll see a difference in the pupils' reactions and you may be sure this will be tried at home. if there is a baby.

Hero's turbine is also made just as effectively using a pyrex baby bottle, a one hole stopper, and a glass tube nozzle with its two right angle turns, all suspended by a thread over a flame.

Toy steam engines are still a most effective means of showing the reciprocating type engine. Be sure to get one that uses a fuel and not electricity for heating. Let the engine wind up a small wad of paper attached to a thread on its shaft to show work being done. In all these steam demonstrations. the use of only 5 or 6 medium droppers full of water will insure fast action and plenty of steam for several minutes operation.

Jet propulsion is most easily demonstrated by releasing a balloon filled with hot air. A more effective demonstration is made by using a half-pint size alcohol or gasoline blow torch. Suspend a wire coat hanger by a heavy thread. On one end of it, hang the blow torch and on the other a weight to counter balance it. As the blow torch pushes out the burned gases, an equal and opposite reaction pushes the blow torch and hanger around. To show how the turbo-jet compressor and turbo-supercharger work, form a turbine rotor from a tin can lid with blades formed around its circumference with pliers and a small nail for its shaft. When the blow torch flame of burned gases is played against its blades, it will rotate.

Rocket propulsion differs from jet in that the rocket carries both fuel and oxygen supply. A good demonstration of this is made using a July 4th fireworks pinwheel.

THE GASOLINE engine demands much more attention when a model airplane engine is demonstrated and disassembled. In running one of these little gasoline engines, a sturdy mount is necessary. Use either screws to hold it down on a heavy board or table, or use "C" clamps to clamp it to the edge of a desk or table. Always rotate the propellor to make sure it clears all obstacles before starting. Using only a screw driver, the engine can be taken apart to examine piston, cylinder, crank shaft, and other parts.

For more experiences with simple materials, look up these books: Lynde, C. J., *Science Experiences with Ten Cent Store Equipment.* Yates, R. F., *Fun With Your Microscope.*

News and Announcements

Chicago Convention of NSTA

The National Science Teachers Association will hold its convention in Chicago at Hotel Sherman December 26-30. You will not want to miss the Forum on the Effectiveness of Science Teaching, the Junior Scientists Assembly, the round table on Relations of Science Teaching with Industry, the Demonstration Meeting in Physical Science, the Audio-Visual Aids program for science teachers and our Annual Luncheon in tribute to the life and work of Dr. Otis W. Caldwell. The chief speakers at the Luncheon will be Dr. Harlow Shapley, president of the A.A.A.S. and Dr. Harold Hunt, Superintendent of Schools in Chicago. The complete program of the meeting will go to members in Packet No. 3.

Program High-Lights of NSTA Convention

Hotel Sherman

Saturday, December 27, 1:30 P. M., Louis XVI Room, *Junior Scientists Assembly.*

Sunday, December 28, 1:30 P. M., Crystal Room. *Relations of Science Teaching with Industry,* G. Edward Pendray, presiding.

Monday, December 29, 9:00 A. M., Club Room. Joint session with the A.A.A.S. Cooperative Committee. G. P. Cahoon, presiding. *Some Current Researches in the Institute for Nuclear Physics.* Samuel K. Allison.

Monday, December 29, 10:00 A. M. Joint Session with Coop. Com., Club Room. L. W. Taylor, presiding. *Simplicity in Demonstrating Physics.* Richard M. Sutton. *Some Demonstrations of Use in Teaching Chemistry.* Frederick B. Dutton.

Joint Session with Coop. Com., Grey Room. Hanor A. Webb, presiding. *Homemade Motion Pictures for Laboratory Teaching in Biology,* Zachariah Subarsky. *Instructional Aids in Mathematics.* E. H. C. Hildebrandt. *Visual Aids in Chemistry.* James Irving. *Physics in Cartoons.* Robert S. Shaw.

Monday, December 29, 12:30 P. M., Club Room. Annual Luncheon of National Science Teachers Association.

Tuesday, December 30, 2:00 P. M., Bal Tabarin Room. Joint session with Cooperative Committee. Glen W. Warner, presiding.

A Chemist Looks at Science Education. C. H. Sorum.

Science in General Education. Vivian Johnson.

Science for Science-Talented Youth. Morris Meister.

New Equipment and Teaching Aids

New electric measuring instruments, capable of providing a continuous analysis of flowing streams of fluids and gases, together with automatic control of those processes has been announced by the General Electric Company. They give promise of advances for the chemical industry.

A light weight, compact, portable sound or silent movie projector at a moderate price is now being offered by the De Vry Corporation.

Now cataloged in one attractive folder is the complete line of S. V. E. projector models and projection accessories. Write to Society for Visual Education, Inc., 100 East Ohio Street, Chicago.

Coronet Instructional Films announce two new films on *mammals;* one of the "Western Plains" and one of the "Rocky Mountains." Each is one reel, sound, color or black and white.

A 1947 catalog of films is available from Brandon Films, 1600 Broadway, New York City.

"Johnny Learns His Manners." a teaching movie, from Pictorial Films, Inc., recently received the first selection for merit from the committee for Biological Science functioning at the Films of the World Festival in Chicago.

Write for It

Science Creates a Modern Industry is a unit dealing with rayon and suited for use in general science. Write to American Viscose Corporation, Box 864, General Post Office, New York 1, New York.

Eat Right to Work and Win, a sixteen page booklet for use in teaching nutrition, is available from Swift and Company, Department E., Chicago 9, Illinois. It is written in lively style and uses comic strip characters.

Adventures in Jet Propulsion, a sixteen page booklet presenting the facts in comic strip fashion, obtained from the General Electric Company, Educational Service Division, Department 6-237, Schenectady 5, New York.

A *Teaching Kit* may be had from the Ralston Purina Company, Nutrition Division, Cereal Department, Checkerboard Square, Saint Louis 2, Missouri. The kit deals with breakfast and wheat.

A bulletin board poster showing A Few of the 200,000 Products Derived from Bituminous Coal can be obtained from Bituminous Coal Institute, 815 Southern Building, Washington 5, D. C.

Set of Pictures on Air Flight may be obtained from United Airlines, 5959 S. Cicero Avenue, Chicago, Illinois.

National Science Teachers Association Resolutions

Adopted at the Official Meeting of the Board of Directors, Netherland Plaza Hotel, Cincinnati, Ohio, Sunday, July 6th, 1947.

I. Be it resolved that the members of the National Science Teachers Association, having learned with profound regret of the death of Dr. Otis W. Caldwell—a founder, a counselor and a friend—extend sympathy to Mrs. Caldwell and to the family in the full knowledge that their loss is partially compensated by the realization of the long and useful life that he has lived. His teaching of science has been an inspiraton to thousands of science teachers throughout the nation. His philosophies of education will long endure in the minds of those who read his articles and observed his methods. Those who were favored by close personal association with Dr. Caldwell will treasure their recollections of him among their choicest memories.

II. (Resolved)

That the National Science Teachers Association continue its efforts to furnish to science teachers and school administrators, direct aid useful in developing programs of science instruction suited to local needs.

For example: Plan and direct experimental investigations to determine the level at which science concepts may be effectively introduced in a twelve year science program.

(2) Continue the evaluation and distribution of industrially prepared educational materials.

(3) Increase the emphasis on the gathering of brief accounts of effective teaching procedures at all levels of science instruction for publication and distribution to members.

III. (Resolved)

That the National Science Teachers Association shall exert influence for the development of more effective means for the early discovery and continuous cultivation of science talent.

IV. (Resolved)

That the National Science Teachers Association Committee on Legislation be instructed to continue its efforts to obtain the serious consideration by Congress of measures that shall raise the standards of and equalize the opportunities for science instruction in the schools throughout the nation.

V. (Resolved)

That the Natoinal Science Teachers Associatoin work continuously toward providing the Association with the services of a full-time executive secretary.

VI. (Resolved)

That the National Science Teachers Association continue to maintain a cooperative relationship with the U.N.E.S.C.O. and with the advisory commission recently appointed by the Department of State to effect further improvement in International and intercultural relations through science teaching.

VII. (Resolved)

That the National Science Teachers Association develop further its plan for decreasing the lag between developments in pure and applied science and the inclusion of the study of these developments in the science curriculum.

VIII. (Resolved)

That the National Science Teachers Association hereby commend those states and municipalities which have recently established more adequate salary schedules for public school personnel.

IX. (Resolved)

That the National Science Teachers Association hereby commend industrial concerns who have set up special programs for the purpose of furthering the acquaintance of science teachers with new developments and industrial applications of science.

X. (Resolved)

That the National Science Teachers Association provide more definitely for disseminating information of general public interest to press and radio services, for providing pertinent news releases to educational journals, and for informing members of the work and accomplishments of the Association through such media as the Official Journal and other publications.

XI. (Resolved)

That the National Science Teachers Association express its appreciation

(1) To its retiring Treasurer, Dr. George Rawlins Jr. and to the retiring Directors, Mr. Emil L. Massey, Mr. M. A. Russell and Mr. Paul R. Young.

(2) to the Association officers and committee members who have contributed to the work of the Association during the year; and

(3) to the committee who has been responsible for making local arrangements for the Cincinnati meeting, Mr. Kenneth Vordenberg, Mr. Norman R. D. Jones, Mr. Walter D. Tallman, Mr. Nathan A. Neal and Dr. Morris Meister.

Signed)

Anna E. Burgess
J. C. Chiddix
J. W. Galbreath
R. W. Lefler, Chairman
Greta Oppe
Harold E. Wise
Kenneth E. Vordenberg

SCIENTISTS WANT FREEDOM

Continued from Page 167

They were reported by an eavesdropper who overheard the word "galvanometer" mentioned in a conversation.

NUCLEAR physicist Philip Morrison, of Cornell University, decried the wave of hysteria engendered by bomb spy headlines. The effect of imposing secrecy in science was both to retard and handicap science everywhere and to withhold technological and health benefits from the American people. At best, and in limited areas, secrecy might only delay slightly the discovery of some scientific facts by scientists in other nations. Secrecy, Dr. Morrison stated, "has become a threat to science itself," and, "The little black notebook of the detective novel is no great start towards atomic bombs." Secrecy, he pointed out, "is used against any liberalization of the control of atomic energy, and to maintain it firmly in the military sphere." This is an illusion to the continuing struggle, that big industry has not given up, to frustrate the Civilian Atomic Energy Control Commission in its duty to take over real control of nuclear energy for the benefit of the American people.

Following the reactionary pattern of the Rankin-Thomas Committee, a number of states have set up so-called little Dies committees. The air has been all but cleared of commentators having the least trace of liberalism. The unwary are being intimidated, and anti-democratic groups are becoming bolder. There have been instances where, under false banner of patriotism and veteran interest, they have resorted to physical violence. The House Committee on un-American Activities does not seem to notice these enemies of our democracy, but, rather, helps to maintain the supply of emotional fuel.

THE PICTURE is not entirely bleak. Our democracy will live so long as there are those, in the words of J. Raymond Walsh, "who have faith in the concept of civil liberties," and will act on that faith. "It is certain," Thomas Jefferson wrote, with reference to the Bill of Rights, "that written constitutions may be violated in moments of passion or delusion, but they furnish a text to which those who are watchful may again rally and recall the people." The PCA rally demonstrated that the faith is not lacking.

Another stimulus was given the defenders of civil liberties by the spirit of the recommendations, made public late in October, by the President's Committee on Civil Rights. Everyone interested in carrying forward the fundamentals of American freedom would do well to read this report. (It is available for ten cents from the newspaper *PM*, New York City). It is, in large part, a healthy report. It is healthy because it does not try to pin false flowers of purity on our lapel. It is a clear expression of the nature of the freedoms we cherish while, at the same time, acknowledging that our house is not entirely clean. When the American people express pride in our heritage of the Bill of Rights and show a determination to extend its benefits more fully to those in our land to whom these freedoms now are being denied, then, I say, America lives. Then, I say, we can walk with head high. This is U. S., the U. S. A.

SCIENTISTS in the PCA call for a full clarification of secrecy regulations imposed upon scientists and for full restoration of the traditional freedom of expression and international interchange of scientific personnel and information. Congressman Sabath has introduced House Resolution 46, to abolish the un-American Committee. The scientists petition members of Congress to support this Resolution. Had the recommendations of the President's Civil Rights Committee been made public earlier, I have no doubt it too would have had their vigorous support. It is to be hoped that the President will hear from the nation and take steps to implement the recommendations of his committee.

LABORATORY METHOD

Continued from Page 165

While the writer's teaching has been only in the field of physics memories of laboratory experiments (?) in high school and college chemistry and biology tend to confirm the need for a real experimental approach to all science laboratory work. This problem, which as Mr. Meister points out, is so vital to the

Continued on Page 190

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ATOMIC AGE

Continued from Page 158

laboratory work? And, on the college level, is the trend towards larger and larger lecture classes, with 200 or 400 students in one room, likely to help develop "logical reasoning" as much as it will gratify the budget-trimmers?

SUCH PROBLEMS will surely become more severe in the "Atomic Age". There will be an increased interest in science on the part of the general student, particularly if our teaching is geared to his interests. And there will be an increased number of students training to become science specialists. The war has catalyzed the growing need for specialists in several ways: 1) by the enormous expansion of scientific research undertaken because of necessity, to supply the means of victory; 2) by the drafting of college men without regard to the scientific and technical post-war needs of the nation, thereby creating a great deficit of specialists in all fields of science which must now be made up; and 3) by the widespread dissemination of scientific knowledge to members of the Armed Forces, resulting in the discovery by many men and women, who might otherwise not have known it, of the fascination which science holds for them and their aptitude for it. The future appears to call for more science teachers, more laboratories, more visual aids and other equipment.

Essential for the success of our task is an interest on the part of all teachers of science in the promotion of science teaching at all levels. This interest must extend at least to the point of being familiar with what the science teachers are trying to achieve at each level. Mr. Charles Gramet, Administrative Assistant in one of New York's high schools, is to be applauded for pleading, through the pages of *Science*, that college science professors not "remain aloof" from the problems of high school science education.[6] It is bordering on irresponsible negligence for a college teacher of freshman science to be unconcerned with what the high schools have attempted in his

6—Charles A. Gramet: "High School Science", *Science*, vol. 103, 1946, p. 149.

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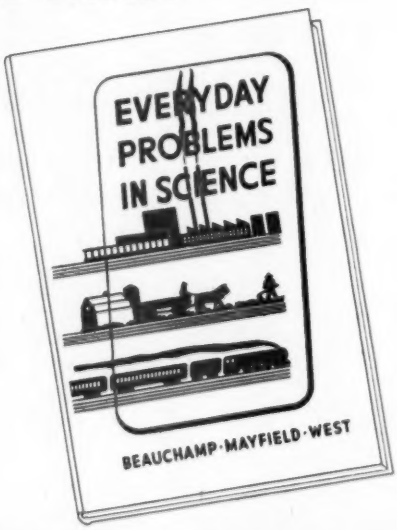

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subject and how well they have succeeded. Even to the instructor in the graduate school it is a matter of concern at what age science teaching is begun, whether there is any integrated plan, or if there is unnecessary duplication in science teaching.

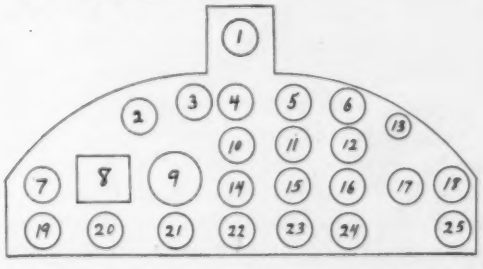
(Concluded in February issue.)

AIRCRAFT INSTRUMENTS

Continued from Page 161

4. Remote reading compass.
5. Oil pressure.
6. Tachometer (R.P.M.).
7. Air speed indicator.
8. Gyrocompass.
9. Artificial horizon.
10. Suction gauge.
11. Oil temperature.
12. Oil pressure and fuel pressure combination.
13. Auxiliary tank fuel gauge.
14. Chronometer.
15. Gas gauge.
16. Gas gauge.
17. Landing gear and flaps position indicator.
18. Hydraulic pressure.
19. Altimeter.
20. Turn and bank indicator.
21. Rate of climb indicator.
22. Radio compass indicator.
23. Cylinder head temperature gauge.
24. Carburetor air temperature gauge and free air temperature gauge.
25. Hydraulic brake pressure.

The plan below shows the arrangement of aircraft instruments in the photograph on page 161.



DISSOLVING THE WALLS

Continued from Page 175

the advancement of human well-being. What is far more important is a recognition of the potential of human welfare inherent in scientific knowledge which existing social machinery fails to exploit . . . Consider the dangers with which the preservation of democracy is now faced. One is failure to anticipate the dire penalties we may pay for the misuse of science . . . Education for citizenship demands a knowledge of how science is misused and a vision of what human life could be if we planned our resources intelligently."

We had not come across these sentences of Hogben's when we produced our own Science Festival a few years ago, but his words accurately express the theme of one of our most interesting adventures in "Dissolving the Walls of the Classroom," an adventure to which nearly every corner of the school contributed its share, from dramatists and scene designers, to actors, dancers, electricians, and chemists. We had been studying the nitrogen compounds and their double role as preservers and destroyers of men. We decided to write a play in the style of a Living Newspaper about this duality in man's use of science. A number of students and teachers spent many hours working together on the history of nitrogen compounds, from the earliest days when men, knowing nothing about science, lived and fought for survival in an economy of scarcity, to the time when Friar Bacon grinding up the nitrogen compound, saltpeter, with other chemicals succeeded in making gunpowder, while in another age and country, Glauber discovered the use of the same saltpeter for fertilizing the fields. We traced the story of the discovery of saltpeter beds in Chili and the mad scramble for the possession of these deposits. There followed the gloomy prophecy of Sir William Crookes, foretelling the exhaustion of the deposits and the impending nitrogen starvation of mankind. Next, we dramatized the amazing discoveries of scientists in various countries, who had accepted the challenge and were finally able to take the useless nitrogen from the air and convert it into useful nitrates. Finally came war with its madness and destruction and at long last, the peace, when it seemed as though men might cease their struggles and develop an equitable way of life, with an economy of abundance, made possible by science.

WE WANTED to write a last scene, and we insisted that it be honest. We wanted no sterile cynicism or sugared sentimentality. We rewrote the scene at least five times, the final draft completed a bare twenty-four hours before the performance. It was unpolished and rough, but it was written with sincerity and hope, a joint effort of many minds groping toward a common goal. We tried to show, in dramatic terms, the aftermath of war and destruction—the hunger, the misery, the disease, the dislocation of all normal living. Ordinary people, groping for answers to their almost insoluble problems, called on the experts, the engineer, the doctor, the economist, the educator. The experts agreed that science had made possible an economy of abundance, that a decent life was attainable for all. They pointed out that a moratorium on science and invention, as some suggested, was no answer, for the very tools that could bring abundance, and health and a better life would thus be unavailable. The answer, they finally agreed, lay in all the people working together, the expert along with the common man—all determined to see to it that science be used for good rather than ill. The play ended on the note of hope voiced by Carl Sandburg in "We, the People":

"Man is a long time coming.
Man will yet win.
Brother may yet line up with brother."

Those of us privileged to work together on this dramatic adventure will never forget the experience. We teachers learned more than we taught and I have an idea that both we and our students were the richer and wiser when we returned to our textbooks and our test tubes. Never again would the study and the laboratory be for us places isolated from the world we live in.

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THIS AND THAT

Continued from Page 160

Times, Dr. E. K. Graham of Washington University and Norman R. D. Jones. It is hoped that all N.S.T.A. members will urge their pupils to enter exhibits in the various Fairs being held. It would help tremendously if you would devote some laboratory time to assist or direct pupils in developing their exhibits.

Science Masters' Association

The Science Masters' Association, which is a corresponding organization to N.S.T.A. for Great Britain, recently carried a second article in its official publication "The School Science Review," by Dr. R. C. Evans of Cambridge, England concerning the activities of N.S.T.A.

Dr. Evans was the first N.S.T.A. member from England. In 1945 he wrote a "note" for their journal giving the aims and objects of N.S.T.A. as well as stating that membership was available to British members. As a result between 75 and 100 members enrolled in N.S.T.A. In the October, 1947 issue of the School Science Review Dr. Evans told, among other things, of the value of our "Packet Service."

At the time of writing, 44 letters several of which represent two or three applications requesting memberships as a result of this article have been received.

N.S.T.A. is happy to welcome those desiring membership.

Any member of N.S.T.A. desiring membership in the Science Masters' Association enclose $2.65 ($2.53 exchange plus mailing costs) to the writer of this column and negotiations will be completed for you.

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Mr. Elra Palmer, Supv'r of Science of the Baltimore, Maryland Schools.

Changes in Location

Some recent changes are:

Mr. Raymond J. Tallman to Tarrytown, N. Y.; Mr. W. A. Lafferty to Knoxville, Illinois; Miss E. Dorothy Sindels to Syracuse, N. Y.; Mr. Thomas I. Dowling to Columbia, S. C.; Miss Emilie M. France to Roseburg, Ore.; Miss Dorothy Schultz to Jackson, Mich.

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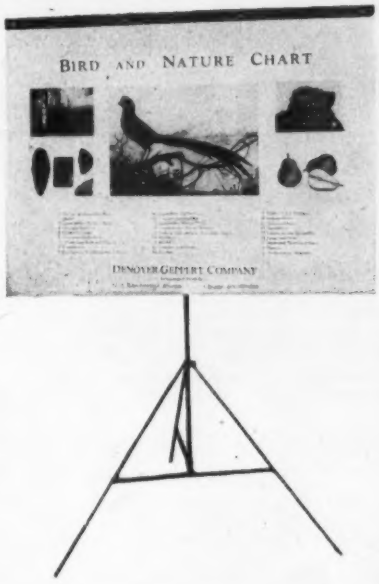

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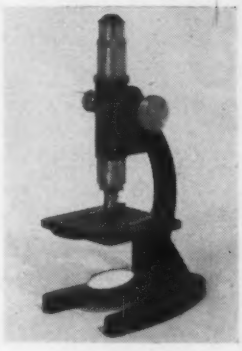

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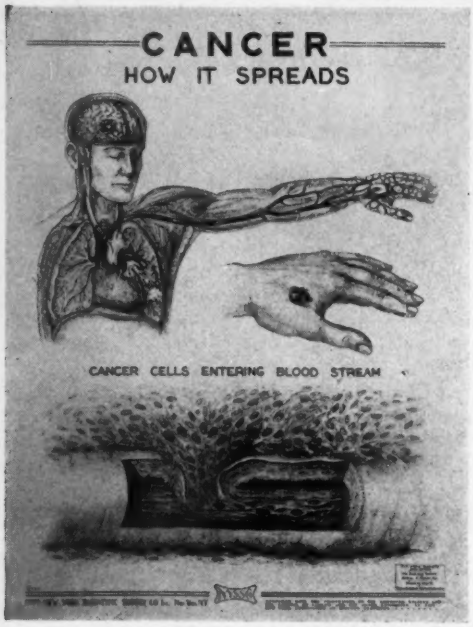

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AUDIO-VISUAL AIDS

Continued from Page 177

hindrance to the development of an audio-visual program. The wartime scarcity of equipment is rapidly being corrected. The purchase of adequate equipment will soon be possible by all schools with sufficient funds.

2. Many teachers hesitate to use projection equipment because of lack of experience. They have had no opportunity to learn the necessary procedures in college, and do not know where to turn for help. An in-service training program could be set up in many schools to aid these teachers. Also attendance at one of the increasing number of summer session courses in audio-visual aid practices would solve the difficulty. There is a need in our colleges and universities, at both the undergraduate and graduate level, for more emphasis upon the training of prospective teachers in the use of audio-visual aids. Of course, we must recognize the fine progress already made in numerous institutions.

3. It is also evident that some teachers are in a rut and neither know nor want to know about the newer methods of education.

Conclusion

The value of the use of projected audio-visual materials in science courses cannot be doubted. Projectors will be available for all who need them. A wealth of material is at hand in the many extensive rental libraries established throughout the nation. Our science students want the benefits to be gained by the use of these aids, and yet it appears that scarcely more than half of these young people are enjoying this advantage.

Now is the time for the science teachers of the United States to awaken to the opportunities open to them to more effectively train our high school youth.

LABORATORY METHOD

Continued from Page 182

future of our scientific advance, seems to be worthy of real study by all in the science teaching field. As exponents of the scientific method in the solution of all our problems it does not seem as if we can afford to let this challenge go unanswered.

BOOK SHELF

LABORATORY INTRODUCTION TO CHEMISTRY. Elvert C. Weaver, Phillips Academy, Andover, Massachusetts. McGraw Hill Book Company, Inc., New York City, 1947. 250 pp., 20x28 cm. Illus. $1.68.

The experiments in this manual are presented exceptionally well both for the convenience of the teacher and for instruction of the student. Aside from good format for working out the experiment and checking, the student is forced to react to a few searching questions at the end of the experiment that lead to an understanding of the significance of the work. The experiments are also unique in being introduced by a short paragraph that both clarifies and adds interest to the work. The experiments are adjusted to the short laboratory period. However, those having double periods will find there is ample work so that two experiments may be done instead of one. There are numerous variations of standard experiments that will interest many teachers. Fifty-one exercises are included as an appendix. These will be found useful for drill and for work in areas for which no experiment directly applies. The manual can be used with any text.

THE REACH OF THE MIND. J. B. Rhine. William Sloane Associates, Inc., New York, 1947. 234 pp., 13x21 cm. $3.50.

"What are we human beings, you and I?" is the question Mr. J. B. Rhine attempts to answer, or rather, to lead people to think about. Is there such a thing as telepathy, clairvoyance, and power of mind over matter? Those who have convictions and those who do not will find most interesting the data presented from research work in this field about which there is much controversy. The prospects for application and the consequences for relation among men are challenging to the imagination

FUNDAMENTAL ACTIVITIES IN CHEMISTRY. Bernard Auerbach and A. Edward Tedesco. Republic Book Company, Inc., New York City, 1947. 342 pp., 17x25 cm. Illus. $.90 net.

This is an up-to-the-minute workbook and laboratory manual which includes such recent developments as nuclear fission and new discoveries in industrial and consumer chemistry. It is organized into thirteen units consisting of experiments and exercises. Each is introduced with a preview followed by experiments and exercises to integrate the laboratory work with background information. Both the *Chemical Mathematics* and the *Organic Chemistry* units are unusually complete.

Considerable provision is made for review of problem solving and equation writing in successive units. A unit vocabulary outline and project list are included with each unit. Page references are also given for the use of many texts. The book should be found very useful where a combined manual and workbook is desired.

DISCOVERING OUR WORLD, Book Three. Wilbur L. Beauchamp, Mary Melrose Williams, and Glenn O. Blough. Scott Foresman and Company, Chicago, 1947. 304 pp., 18x24 cm. Illus. $1.64 list.

Discovering Our World, Book Three for the sixth grade is the third in a series for the middle grades and follows Book One for the fourth grade and Book Two for the fifth. All are by the same authors. As in the other books a multiude of real experience is provided that permits the pupils to grow in rich science background experience and understanding. In many areas experiments are suggested that can be successfully carried out at the sixth grade level, using very simple materials mostly available to the average grade teacher.

In each unit there is a wide variety of learning experiences, all contributing to a grasp of the generalizations that grow out of the material.

The material is interestingly written in the language of the sixth grade level. The pictures are effective teaching aids and are done in four colors. Students will want to read the book.

A Teacher's Edition is available containing the complete pupil's text plus a Guidebook. The cost is the same as for the pupil's edition.

PHYSICS FOR THE NEW AGE. Robert H. Carleton, New Ark College of Engineering, Newark, N. J.; and Harry H. Williams, Horace Mann School for Boys, New York City. J. B. Lippincott Company, Philadelphia, 1947. 656 pp., 15x22 cm. 452 illus. $2.80 list price.

The logical organization of this book in suitable units which in turn are broken down into challenging problems makes it especially effective for instruction in high school physics. The student is given a clear-cut framework about which he may organize his ideas with understanding of the subject.

As its name implies the text makes use of modern equipment and applications of physics in the study of principles, thus adding much to interest of students. For example, included are the automobile, airplane, air conditioning, jet propulsion, rockets, electronics, television, radar, and splitting the atom.

The book is profusely illustrated and contains some pictures in color. A number of diagrams are of the white-on-black type.

A special help to the student are the example problems which are worked through to the last step to illustrate the method. To care for individual differences the problems are divided into A and B sections according to difficulty. The text should prove very desirable for high school instruction.

LABORATORY EXPERIMENTS—EXERCISES TO ACCOMPANY BASIC CHEMISTRY. Ernest E. Bayles, University of Kansas; and Arthur L. Mills, Lake Geneva High School, Lake Geneva, Wisconsin. The Macmillan Company, New York, 1947. 226 pp., 20x28 cm. 64 line drawings.

Laboratory Experiments can be used as a manual to accompany any high school chemistry text. It has more than enough experiments for a minimum basic course, permitting of latitude of selection according to teacher and pupil needs or interests. Rapid workers can have additional work to do.

Experiments are quite comprehensive, thus permitting the teacher to select the parts desired. If an entire experiment is too long for one day, it can be completed at another time.

For the parts of a chemistry text that do not lend themselves to experiment, such as atomic structure, there are special exercises that may be done either during the laboratory period or outside of class. Part of the laboratory experiments may be used as demonstrations.

SCIENCE. Revised Edition. Ira C. Davis, University of Wisconsin; and Richard S. Sharpe, George Washington High School, New York City. Henry Holt and Company, New York, 1947. 534 pp., 15½x23½ cm. 575 Illus. $2.36.

Teachers who are acquainted with *Science* as a text in general science will find it not only brought up to date in content, but also considerably improved in the 1947 edition. The organization of the book remains the same. Each unit is organized around a large problem which in turn is broken

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Biology Projects

(Published, October, 1942)

Included among these projects are: loss of soil elements by leaching, test tube plants and root hairs, food elements of plants, how to make a cross section of a stem, using light to make glucose and starch, when plants breathe like people, heat of respiration in plants, what causes liquids to flow in plants, identification of trees, the house fly and what he carries, controlling insect pests, digestion, checking your posture for health, charting your teeth, susceptibility to tooth decay, making media of correct pH to grow bacteria.

47 Projects, 100 pages, mimeograph $1.25

General Science Projects

(Published, October, 1942)

Among the projects are the following: amateur range finding, how to navigate by sun and stars, weighing without scales, making and using solutions, seven ways to start a fire, seven ways to put out a fire, chemical indicators, a rock mineral collection, a pin hole camera, printing pictures, learning to be a radio amateur, a pendulum project, testing foods at home, digesting food with saliva, canning food, how good are the arches in your feet, surveying the teeth, and clay modeling and casting.

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down into specific problems for learning. Included are activities for gaining necessary experiences to deal with the work.

The material of the book is related to common activities, experiences and interests of the pupils. The vocabulary is limited to the minimum required for the subject. At the beginning of each unit is a list of the words needed to understand the material. The language has been simplified and can be more readily understood by the average student. The range of students who can successfully study this text has been greatly extended.

BASIC CHEMISTRY. Ernest E. Bayles, University of Kansas; and Arthur L. Mills, Lake Geneva High School, Lake Geneva, Wisconsin. The Macmillan Company, New York, 1947. 720 pp., 14x21 cm. 356 Illus. $3.00.

As a high school text *Basic Chemistry* differs from other books in some important ways. The most important innovation is an attempt to lead the student to think through the principles and problems of chemistry in a natural learning manner. The student is consistently presented problems for which facts are provided to solve. The student is led through to an understanding of the problem or theory presented.

The book begins with a study of water softening as a common chemical problem. The order of arrangement of the book differs somewhat from traditional texts. A study of colloids is placed with solutions. A study of the periodic arrangement follows a series of studies to give the facts upon which it is based. Considerable attention is given to nuclear structure of atoms to provide a basis for understanding atomic energy.

The illustrations are clear, attractive, and easily understood. The book will no doubt prove to be a very teachable text.

ANYWHERE IN THE WORLD. Irma E. Webber. Published by William R. Scott, Inc., New York, 1947. 64 pp., 16x19 cm. Illus. in color. Cardboard covers. $1.50.

Anywhere in the World tells in simple language about plants, animals, and weather in many parts of the world. It has numerous colored drawings that make the book attractive. It is suited to the second to fourth grade levels.

FUNDAMENTALS OF SEMI-MICRO QUALITATIVE ANALYSIS. Carl J. Engelder, Professor of Analytical Chemistry, University of Pittsburgh. John Wiley and Sons, New York, 1947. 385 pp., 13.5 x 21 cm. $3.50.

In this book the author attempts to integrate the theory of qualitative analysis with the laboratory work so that the student will be intelligent about what is attempted and able to control conditions under which reactions are run and to interpret the results.

In order to accomplish his purpose the author has introduced the cation groups in reverse order before a complete systematic analysis is attempted. The alkali metals are first studied, followed by the alkaline earth elements. This provides the time for discussing the solubility product. Group III and oxidation and reduction are studied together, etc. Preliminary experiments followed by group analysis acquaints the student with the cations studied. A complete analysis of the cations follows the analysis of anions.

Many problems are included in the sections of the book dealing with theory. Half of the problems of each group have the answers omitted.

Part of the book, including analytical procedures, is taken from *Semi-Micro Qualitative Analysis* by Engelder, Dunkelberger (and Schiller.

ELEMENTARY BACTERIOLOGY. Joseph E. Greaves and Ethelyn O. Greaves, Utah State Agricultural College, Logan, Utah. Fifth Edition. W. B. Saunders Company, Philadelphia, 1946. 613 pages, 13.5x19.5 cm., with 169 illustrations. Price $4.00.

Elementary Bacteriology is not only an easily read and interesting text for the beginner in this field, but it will hold the attention of any one interested in the area. As the author puts it, less attention is given to classification and morphology so that greater consideration can be given to physiological action of the important group of microorganisms known as bacteria. Considerable attention is given to bacteria in relation to fertility of soil, to nutrition and to some important diseases.

This fifth edition has been drastically revised, many chapters having been re-written and new material added. Among the topics not previously included are the use of solid media containing agar-agar, the development of antiseptic surgery, sulfa drugs and penicillin, and the great advance in viruses. A chapter on antibiotics has been added. The work on botulism is given less attention due

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to the fact it no longer presents a problem of first magnitude.

Questions given at the end of chapters are a help to teacher and student in learning. Many references are included.

The book should be of interest as a high school reference as well as a college text.

Furry, Margaret S. and Viemont, Bess M., HOME DYEING WITH NATURAL DYES. Miscellaneous Publication No. 230, USDA. 36 pages, 1935. Superintendent of Documents, 10 cents.

Discusses dye standards of fastness, desirable color combinations, equipment for dyeing and procedures. About 65 natural dye materials were tested and are reported in this publication. Useful natural dyes are reported with instructions for treating the fabrics and recipes for dye materials and extracts. Suggests how other dye material may be tested. Especially useful in the encouragement of home crafts.

Garver, Harry L., SAFE WATER FOR THE FARM. Farmers' Bulletin No. 1978, USDA. (Supersedes Farmers' Bulletin No. 1448.) 46 pages, 1946. Superintendent of Documents, 15 cents.

This bulletin supplies information concerning the sanitary and engineering principles to be observed in providing safe fresh water for rural homes. Topics discussed include sources of water, types of wells and pumps with advantages and disadvantages, and treatment of water, including removal of iron and other minerals. Construction of wells and water storage facilities are discussed in useful detail, including places for fire protection and small plot irrigation. This publication would provide useful information for teachers and pupils and would suggest projects for interested students.

Holman, A. T., FIRE FIGHTING ON FARMS. Miscellaneous Publication No. 612, USDA. 54 pages, 1946. Superintendent of Documents, 15 cents.

The fire hazards in rural homes and communities are recognized by suggestions for an action program involving training farm firemen, kinds of fires and methods for extinguishing, equipment needed, and checks on fire prevention practices. The bulletin could be used in stimulating elementary and secondary school pupils to project work involving checking for fire hazards and initiating the removal of hazards. Activities for pupil and group project are numerous. This bulletin should be read and discussed in every rural secondary school.

INTEGRATION TEST

Continued from Page 169

pressure of a 30 year old man? What will be the approximate change in your blood pressure when you become ten years older?

17. What is a box wrench? State four advantages which a box wrench possesses.
18. State the uses of a hickey.
19. For what purpose has a yarning iron been used in your home?
20. Explain the meaning of each underlined word in the following sentence:
    With an anastigmat lens, within the hyperfocal distance, it is possible to take a high-key picture having chiaroscuro, notan, and genre.

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INDEX TO VOLUME XIV

A High School Mechanical Teaching Device, Max Epstein, 34.

A Laboratory Method for High School Physics, Walter H. Hellman, 165.

A Message From the Elementary Science Editor, Dwight E. Sollberger, 30.

A Projection-Type Galvanometer, Ralph H. Hall, 68.

A Science Congress As A Community Project, Madeline Frink Coutant, 170-3.

Adaptable Equipment for Use in General Science, Louis T. Cox, 178-9.

Aircraft Instruments, Into Teaching Devices, Alexander Joseph, 161.

Aircraft Surplus Material, A. Joseph, 28.

Alcohol Problem, Teaching The, Joseph Singerman, 122.

An Adaptable Display Case, E. A. Larson, 70.

Are We Limiting Opportunities for Youth? John C. Chiddix, 16.

Are You Planning A School Garden? Paul R. Young, 66.

Atomic Age, Teaching Science For The, Alex B. Novikoff, 157-8.

Audio Visual Aids, Do You Use, R. A. Bullington, 176.

Chats With Science Teachers, H. A. Webb, 168.

Conservation Education, Proposals of the National Committee on Policies in, John W. Scott, 111.

Display Case, An Adaptable, E. A. Larson, 78.

Dissolving The Walls of The Classroom, Martha E. Munzer, 174-5.

Do You Use Audio-Visual Aids?, R. A. Bullington, 176.

Economic Status of the Science Teacher, Recruiting and the, Raleigh W. Schorling, 11.

Electricity, "High Tension," D. G. Vequist, 132.

Electrolysis, Modernized Teaching of, C. W. Bennett, 120.

Elementary Science Editor, A Message From the, Dwight E. Sollberger, 30.

Equipment for Use in General Science, Adaptable, Louis T. Cox, 129; 178-9.

For Better Science Texts, M. Van Waynen, 64.

Galvanometer, A Projection Type, R. H. Hall, 68.

General Science, Adaptable Equipment for Use in, Louis T. Cox, 129.

"High Tension" Electricity, D. G. Vequist, 132.

How to Increase Natural Resource-Planning, Philip G. Johnson, 113.

Integration Test, Ralph B. DeLano, 169.

Junior Scientists Assembly, H. Zim, 24.

Legislation, The Necessity of Science, K. Lark-Horovitz, 59.

Modernized Teaching of Electrolysis, C. W. Bennett, 120.

Natural Resource-Planning, How to Increase, Philip G. Johnson, 113.

NSTA—In Its Fourth Year, Morris Meister, 159.

Opportunities for Youth, Are We Limiting, John C. Chiddix, 16.

Order in the Department, Addison Lee, 117.

Packets, Science Teaching, B. E. Slye, 28.

Physics, A Laboratory Method For High School, Walter H. Hellman, 165.

Physics Which Require Demonstration In Chemistry, Some Important Principles, Raymond S. Tobey, 162-4.

Place of Science in the Educaiton of the Consumer, Nathan A. Neal, 71.

President's Page, Morris Meister, 114.

Proposals of the National Committee on Policies in Conservation Education, John W. Scott, 111.

Recruiting and the Economic Status of the Science Teacher, Raleigh W. Schorling, 11.

Reflections on Science and Liberal Education, Laurence L. Quill, 14.

Resume, A. J. Carlson, 61.

School Garden, Are You Planning A, Paul R. Young, 66.

Science and Liberal Education, Reflections on, Laurence L. Quill, 14.

Science Club Members Profit From State and National Cooperation, Margaret E. Patterson, 124.

Science Curriculum, Visualizing the, D. F. Schutte, 82.

Science for Freedom, Philip Kotlar, 20.

Science Teaching Packets, B. E. Slye, 18.

Science Texts, For Better, M. Van Waynen, 70.

Scientists Want Freedom, Joseph Singerman, 166-7.

Some Important Principles In Physics Which Require Demonstration In Chemistry, Raymond S. Tobey, 162.
Teaching Device, A High School Mechanical, Max Epstein, 34.
Teaching Science For the Atomic Age, Alex B. Novikoff, 157-8.
Teaching the Alcohol Problem, J. Singerman, 122.
Teen Age Scientists, Dr. Frank Thone, 78.
Test Integration, Ralph B. DeLano, 169.
The Laboratory Problem of the Science Teacher, Morris Meister, 13.
The Necessity of Science Legislation, K. Lark-Horovitz, 59.
Time For Science Instruction, Dwight E. Sollberger, 63.
This and That, Norman R. D. Jones, 31; 77; 115; 160.
Visualizing the Science Curriculum, D. F. Schutte, 82; 130.
We Have Lost A Generation, Morris Meister, 62.

AUTHOR INDEX

Bennett, C. W., Modernized Teaching of Electrolysis, 120.
Bullington, R. A., Do You Use Audio Visual Aids? 176.
Carlson, A. J., Resume, 61.
Chiddix, John C., Are We Limiting Opportunities for Youth? 16.
Coutant, Madeline Frink, A Science Congress As A Community Project, 170-3.
Cox, Louis T., Adaptable Equipment for Use in General Science, 129; 178-9.
DeLano, Ralph B., Integration Test, 169.
Epstein, Max, A High School Mechanical Teaching Device, 34.
Hall, Ralph H., A Projection-Type Galvanometer, 68.
Hellman, Walter H., A Laboratory Method For High School Physics, 165.
Lark-Horovitz, K., The Necessity of Science Legislation, 59.
Larson, E. A., An Adaptable Display Case, 64.
Lee, Addison, Order in the Department, 117.
Kotlar, Philip, Science for Freedom, 20.
Johnson, Philip G., How to Increase Natural Resource-Planning, 113.
Jones, Norman R. D., This and That, 31; 160; 77; 115.
Joseph, A., Aircraft Surplus Material, 28.
Converting Surplus Aircraft Instruments Into Teaching Devices, 161.
Meister, Morris, NSTA—In Its Fourth Year, 159.
President's Page, 114.
The Laboratory Problem of the Science Teacher, 13.
We Have Lost A Generation, 62.
Munzer, Martha E., Dissolving the Walls of The Classrooms, 174-5.
Neal, Nathan A., Place of Science in the Education of the Consumer, 71.
Novikoff, Alex B., Teaching Science For The Atomic Age, 157-8.
Patterson, Margaret E., Science Club Members Profit From State and National Cooperation, 124.
Quill, Laurence L., Reflections on Science, and Liberal Education, 14.
Schorling, Raleigh W., Recruiting and the Economic Status of the Science Teacher, 11.
Schutte, D. F., Visualizing the Science Curriculum, 130; 82.
Scott, John W., Proposals of the National Committee of Policies in Conservation Education, 111.
Singerman, Joseph, Teaching the Alcohol Problem, 122.
Scientists Want Freedom, 166-7.
Slye, Bertha E., Science Teaching Packets, 18.
Sollberger, Dwight E., A Message From the Elementary Science Editor, 30.
Time For Science Instruction, 63.
Thone, Dr. Frank, Teen Age Scientists, 78.
Tobey, Raymond S., Some Important Principles In Physics Which Require Demonstration in Chemistry, 162-4.
Vequist, David G., "High Tension" Electricity, 132.
Waynen, M. Van, For Better Science Texts, 64.
Webb, Hanor A., Chats With Science Teachers, 168.
Young, Paul R., School Garden, Are You Planning A., 66.
Zim, Herbert, Junior Scientists Assembly, 24.

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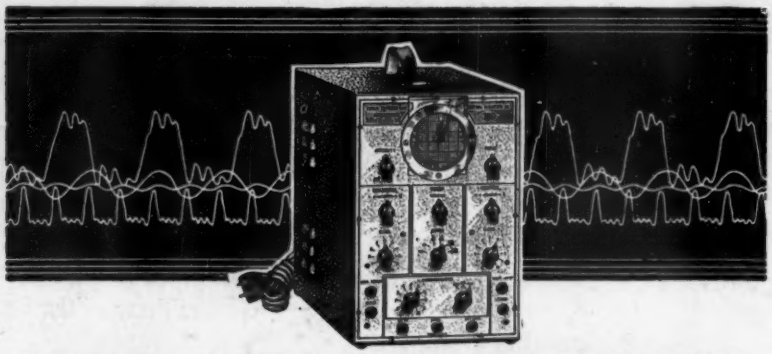

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